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Energy Research Abstracts

Abstracts 33032-35510

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UNITED STATES DEPARTMENT OF ENERGY

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Energy Research Abstracts

Purpose

Energy Research Abstracts (ERA) provides abstracting and indexing coverage of all scientific and technical reports, journal articles, conference papers and proceedings, books, patents, theses, and monographs originated by the U.S. Department of Energy, its laboratories, energy centers and contractors. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations. Foreign information is obtained through the International Energy Agency's 13-nation Energy Technology Data Exchange, the International Atomic Energy Agency's International Nuclear Information System, or nation-to-nation agreements. **Please note that *ERA* coverage of non-report literature is limited to that generated by Department of Energy activity.**

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The citations presented in *ERA* are available for on-line searching as records within the Energy Data Base. The current-year records are available on the Integrated Technical Information System (ITIS). The entire data base is available through commercial on-line vendors.

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ERA is available to the public on a subscription basis from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. The subscription rate for 24 semimonthly issues is $184.00 for domestic subscribers and $230.00 for foreign subscribers. A single issue costs $27.00, domestic, or $33.75, foreign. Cumulative indexes are available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. The GPO Stock Number is 661-000-00000-7 and the price is $174.00 for the Volume 13 indexes.

Managing Editor, Audrey B. Smith
Technical Editor, M. Catherine Grissom

Information Sources

The citations presented in *Energy Research Abstracts* are a subset of the worldwide energy information provided to the Office of Scientific and Technical Information (OSTI) through exchange agreements with foreign sources and through exchanges or contracts with U.S. organizations.

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Canada	Japan
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Italy	United Kingdom
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The **International Nuclear Information System (INIS)** was established to promote the exchange of information on nuclear science and technology. Its operation is similar to that of the ETDE, with the INIS Secretariat being located in Vienna, Austria. Currently, 75 countries and 14 international organizations are members of INIS. OSTI serves as the INIS national center for the United States.

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4. **Author(s).** First 10 names in the data record are printed, then "et al." is listed.
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7. **Corporate author(s)** identifying corporation responsible for document.
8. **Patent assignee and number** for citations of patent documents or applications.
9. **Journal title, volume, and issue** for citations of journal articles.
10. **Date of publication.** If not known, a processing date is in brackets.
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20. **Sources of availability** from which a copy of the document may be obtained; usually appear as abbreviations. (See information on following page.)
21. **Drop note** or explanatory statement.
22. **Abstract.**
23. **Subject descriptors.** Listed only if no abstract or only a brief statement is included.

Sample Citations

Report

18494 (DOE/ER/40438–T1) **[Development of a hydrogen and deuterium polarized gas target for application in storage rings]: Progress report.** Haeberli, W. Phys. VI collaboration. Wisconsin Univ., Madison (USA). Dept. of Physics. [1989]. 12p. Sponsored by DOE Energy Research. DOE Contract FG02-88ER40438. Order Number DE89007246/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This paper briefly discusses the Wisconsin test facility for storage cells; results of target tests; the new UHV...

Report Analytic

18500 (INIS-SU—69, pp. 30-32) **Transition energies in Ne-like ions. Correlation effects.** Vainshtejn, L.A. AN SSSR, Moscow. Fizicheskij Inst. 1988. (In Russian). In *Experimental and theoretical physics. Collection.* Order Number DE89780060/JAW. Available from NTIS (US Sales Only), PC A03/MF A01; INIS.

Kratkie Soobshcheniya po Fizike.; no. 6.

SILVER IONS/energy-level transitions; XENON IONS/energy-level transitions; CORRELATIONS; D STATES; E STATES;...

Journal Article

19055 **A theoretical and experimental investigation of long-pulse, electron-beam-produced rare gas plasmas.** Brake, M.L.; Repetti, T.E. (Energy Beam Interaction Lab. of the Dept. of Nuclear Engineering, Univ. of Michigan, Ann Arbor, MI (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science (USA)*, 16(5): 581-589 (Oct 1988). (CONF-881020–: Symposium on radiation physics, Sao Paulo, Brazil, October 3, 1988).

Visible emission spectroscopy (380-650 nm) has been performed on intense, electron beam (1 kA, 300 ns, 300 kV) produced Ar, Kr,...

Patent

18045 **Polarization of fast particle beams by collisional pumping.** Stearns, J.W. To Dept. of Energy, Washington, DC. USA Patent 4,724,117. 9 Feb 1988. Filed date 19 Oct 1984. vp. Available from Patent and Trademark Office, Box 9, Washington, DC 20232.

A method for polarizing a fast beam of particles by collisional pumping, comprising the steps of generating a beam...

How To Order from the Availability Sources

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Report literature, usually identified by an alphanumeric identifier at the beginning of a citation, is available from the sources listed in the citation (see example of element 20 on page iii). Often the sources are listed as abbreviations. Corresponding addresses are provided at right from which documents with these abbreviations may be ordered. When "OSTI" is given, **DOE and DOE contractors may order these documents from OSTI.** (However, check with your library or information organization which may require that orders go through them to OSTI.) The public should order from NTIS or from one of the other agencies listed in the citation. To expedite processing, an order form is provided in the back of this publication. NOTE: The order numbers provide quicker access for report ordering. Use the order number where possible.

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Vienna, Austria

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Books, conferences, and monographs The source for these publications is the publisher or the originating society, organization, or institution. DOE-supported conferences and individual papers reporting DOE-supported research may be available as reports from OSTI.

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Five indexes are provided for approaching the content of each issue of *Energy Research Abstracts*. Descriptions of entries in these indexes follow.

Corporate Author Index
The corporation, organization, or institution responsible for the issuance of the document is listed in this index. The entries are arranged alphabetically and provide the title and citation number of the reference. For example, the listing for the "Report" sample citation would appear as shown at right.

Wisconsin Univ., Madison (USA). Dept. of Physics
[Development of a hydrogen and deuterium polarized gas target for application in storage rings]: Progress report, 14:18494 (R;US)
Wisconsin Univ., Madison (USA). Lab. of Genetics
Organization of the R chromosome region in maize: Final progress report, June 1, 1983–May 31, 1986, 14:18255 (R;US)

Personal Author Index
Each author's name listed on a document cited in this issue is indexed. An index entry provides title and citation number; for secondary and other names, a cross-reference is given to the primary author name where the full index entry is located.

Hadley, D.L., *See* Lee, A.D., 14:17651
Haeberli, W., [Development of a hydrogen and deuterium polarized gas target for application in storage rings]: Progress report, 14:18494 (R;US)

Subject Index
This index lists the main subject descriptors assigned to each record by indexing professionals. A secondary or qualifier term is used where necessary to describe materials, objects, and processes. Document titles may be enhanced with additional informative phrases where necessary. An excerpt from this index appears at right.

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TRITIUM
Neutron-Rich Isotopes
Study on the strong neutron-rich nuclei of lightest elements, 14:18686 (RA;SU;In Russian)

Contract Number Index
DOE technical reports are listed by contract number. Each entry also provides the primary corporation or organization cited for that contract number. A typical entry is shown.

FG02-88ER40438 **Wisconsin Univ., Madison (USA). Dept. of Physics**
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Report Number Index
Technical report literature is indexed by the alphanumerical identifier of the report. Patent documents and conferences are included for convenience. Each entry lists the citation number, the source of availability of the document, an indicator of presence at a GPO depository library, order number, and distribution category. A typical entry is:

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Subject Contents

The subject content of *Energy Research Abstracts* is arranged as shown below. The two-digit and four-digit category numbers printed here illustrate the category number assignment used in the data base records.* The following list includes all of the 40 first-level and the 289 second-level categories. Because each issue of *ERA* publishes citations only for those documents announced during the past semimonthly period, some subject categories may not be present in every issue.

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*The numerical subject category scheme is used in the storage, retrieval, and manipulation of bibliographic information entered into DOE's data systems. Categories and definitions for the complete set of six-digit numbers are given in DOE/TIC-4584, *Energy Data Base: Subject Categories and Scope*.

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Energy Research Abstracts

01 COAL AND COAL PRODUCTS

0103 Preparation

Refer also to citation(s) 33065, 33133

33032 (CONF-8810170–, pp. 201-229) **Role of ash concentration in coal hydroliquefaction.** Kim, N.K. (Michigan Technological Univ., Houghton (USA)). USDOE Pittsburgh Energy Technology Center, PA (USA). 1988. DOE Contract FG22-87PC79806. From DOE direct liquefaction contractor's conference; Pittsburgh, Pennsylvania, USA; 4-6 Oct 1988. In *Direct liquefaction contractors' review meeting. Proceedings.* Order Number DE89009225/JAW. Available from NTIS, PC A22/MF A01; 1.

The Institute of Mineral Processing at Michigan Technological University has produced superclean coals from the PDU of the static tube flotation columns. Pittsburgh #8 coals (7% ash) were used for the demonstration run, and five coals with ash concentrations ranging from 3% to 43% were prepared by the virtue of flotation. The roles of successively increasing ash content in hydroliquefaction are discussed. Hydroliquefaction of coals has been carried out with tetralin as donor solvent in one liter Parr autoclave. Preliminary results indicate that high ash contents favor the formation of certain compounds.

33033 (CRIEPI-W–87038) **Study of CWM dry preparation systems using water-air mixed jet pump.** Ono, T. (and others). Central Research Inst. of Electric Power Industry, Tokyo (Japan). 1988. vp. (In Japanese). Available from Central Research Inst. of Electric Power Industry, Tokyo (Japan).

In the case of CWM preparation using pulverized coal produced by dry-crushing, it is ordinarily difficult to turn the pulverized coal into CWM owing to its water repellency and the step requires a lot of time. It was therefore proposed, and the possibility examined of a preparation method which turns the pulverized coal into CWM by a jet current from a water-air mixed jet pump. As a result, it was determined that the preparation of CWM using the water-air mixed jet pump can turn the pulverized coal into CWM instantaneously, thus offering a great possibility.

33034 (STEV-TORV–89-4) **Peat characterization and dewatering.** Albano, C. Statens Energiverk, Stockholm (Sweden). 1989. 57p. (In Swedish). Order Number DE89776264/JAW. Available from NTIS (US Sales Only), PC A04/MF A01;1.

This report summarizes the second period of a project devoted to the study of fundamentals concerning peat characterization and dewatering. The project represents the restart of basic peat research in Sweden and its aim is to obtain a fairly complete description of peat. The main project includes the following subprojects: - Botanical characterization. - Microbiology. - Chemistry. - Structure, image analysis. - Physical methods. - Spectroscopy. - Dewatering. - System analysis. More than 6000 peat samples have been collected and raw data from different analyses are compiled. (G.B.).

33035 (TKK-KO/ET–23) **Behaviour, dimensioning and profitability of steam fluidized bed dryer based on experiments carried out in pilot dryer.** Huhtinen, M.; Wilen, C.; Fagernaes, L.; Virtanen, M.; Isoniemi, M.; Haavanlammi, A.; Jahkola, A. Helsinki Univ. of Technology, Otaniemi (Finland). Inst. of Energy Engineering. 1988. 180p. (In Finnish). Order Number DE89776169/JAW. Available from NTIS (US Sales Only), PC A09/MF A01;1.

The purpose of this research and development study has been to collect design and dimensioning information from experiments carried out in a pilot dryer with closed steam circuit. Drying tests were made with peat and bark. Based on experimental results it was able to specify a design and dimensioning of following topics: feeding equipments, distance of tubes in fluid bed heat exchanger, grinding effect of dryer, separators of bed material and dryed material, purification of condensate, drying rate of particles in steam fluidized bed. It is highly important in designing and dimensioning of steam fluidized bed dryers to pay enough attention to prevent steam leakages through feed equipment. With a new dense tube heat exchanger the density of heat exchange rate in bed (W/m^3) could be almost tripled. However the heat exchange coefficient (W/m^2k) was not better than before. The reason for that was that there were still a considerable amount of dryed material with poor heat exchange properties in the bed. Based on design and dimensioning information collected from literature and experiments it has been developed a computer model for simulation and dimensioning the steam heated steam fluidized bed dryer. The economic calculations carried out for two real cases pointed out that in new large power plants steam fluidized bed dryer is a profitable investment.

33036 **Effectiveness of coal comminution by high pressure waterjet.** Galecki, G. (High Pressure Waterjet Lab., Rock Mechanics Facility, Univ. of Missouri-Rolla, Rolla, MO (US)); Mazurkiewicz, M. v.v of The 8th Miami international conference on alternative energy sources. Volume 2. Proceedings of condensed papers. Veziroglu, T.N. Clean Energy Research Inst. University of Miami, Coral Gables, FL (1988). (CONF-871204–: 8. Miami international conference on alternative energy sources, Miami Beach, Florida, USA, 14-16 Dec 1987).

Fragmentation of minerals through the development of compressive stresses within the mineral is not economical when compared to the benefits to be derived from inducing failure under tensile stresses. This obvious fact has not been utilized until recently when high pressure waterjets have been applied for the purpose of coal comminution. High pressure waterjet comminution has several particular advantages. Water penetrates into the cracks enhances fragmentation by developing pressures within the cracks thus promoting further growth. The jet is moving so fast that the jet can effectively follow crack tip propagation, can penetrate along grain boundaries, pressurize material discontinuities and develop a hydromechanical jet action within the increasingly dense crack network which is created within the wall of the cavity. In this paper the experimental procedure is described and the test results presented for the comminution method involving the action of a high pressure waterjet on coal chunks.

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Refer also to citation(s) 33032, 33115, 33116, 33123, 33127, 33133, 33146, 33147, 33150, 33166, 33167, 33178, 33340, 33341, 33345, 33346, 33347, 33348, 33360, 33361, 33811, 33815, 33910, 34047

33037 (ACERR–1989, pp. 5) **Petrographic composition and liquefaction behaviour of North Dakota and Texas lignites.** Parkash, S. (Alberta Research Council, Edmonton, AB, Canada); Carson, D.; Ignasiak, B. Alberta/Canada Energy Resources Research Fund, Edmonton, AB (Canada). [1989]. (CE–02653). In *Alberta Research Council [research reports].* Available from Alberta Energy and Natural Resources, Information Centre, 9920-108 St., Edmonton, AB, Canada T5K 2M4; $N/C.

The objective of this study is to evaluate the role of various macerals of North Dakota and Texas lignites in rapid heating liquefaction with a hydrogen donor solvent (tetralin) in the presence of hydrogen. Two US lignites were fractionated by density with appropriately prepared mixtures of liquid halogenated and non-halogenated hydrocarbons. Petrographic analyses confirmed that the procedure resulted in density fractions enriched in specific macerals. Liquid yields decreased with increase in the density fraction for both lignites. On plotting the total solubilities of lignites and their density fractions versus their huminite contents a linear correlation was obtained, particularly for North Dakota lignite. It is tentatively concluded that in North Dakota lignite, as opposed to Texas lignite, marcerals other than huminite did not significantly contribute to generation of liquid products. The results show that although the total percentage solubility does not differ much from that obtained at 430^0C and 30

min residence time, it seems that the amount of toluene-soluble material is somewhat greater, and the tetrahydrofuran-soluble, toluene-insoluble product yield is substantially lower on short residence time liquefaction. 14 refs., 5 figs., 6 tabs.

33038 (ACERR–1989, pp. 5) **Structural characterization of non-reductively ethylated coal by ^{13}C and ^{1}H n.m.r.** Cyr, N (Alberta Research Council, Edmonton, AB, Canada); Gawlak, M. .; Carson, D.W.; Ignasiak, B.S. Alberta/Canada Energy Resources Research Fund, Edmonton, AB (Canada). [1989]. (CE–02653). In *Alberta Research Council [research reports].* Available from Alberta Energy and Natural Resources, Information Centre, 9920-108 St., Edmonton, AB, Canada T5K 2M4; $N/C.

This paper shows that important chemical-structural parameters may be obtained from the N.M.R. spectra of non-destructively ethylated coal. The parameters reported here are the number of reactive hydroaromatic sites, the aromaticities and the degree of protonation of the solubilized portion of the original coal. Samples of coal ground to 300 mesh were ethylated consecutively three times and extracted with chloroform in a Soxhlet apparatus. The non-reductive alkylation of coal does not cause any chemical rearrangements and renders a significant portion of a tested caking coal soluble in chloroform. Fractionation of the soluble portion based on molecular weight and polarity differences, followed by spectral analysis of these fractions, yields information on both the macromolecular composition and the chemical structures of the soluble portion of coal. 25 refs., 3 figs., 4 tabs.

33039 (AD-A–201393/6/XAB) **Production of jet fuels from coal-derived liquids. Volume 3. Jet fuels potential of liquid by-products from the Great Plains Gasification Project. Interim report, September 1986-December 1987.** Smith, E.B.; Guffey, F.D.; Nickerson, L.G. Western Research Inst., Laramie, WY (USA). May 1988. 46p. Available from NTIS, PC A03/MF A01.

Three liquid by-products from the Great Plains Gasification Project, tar oil crude phenols, and naptha, were evaluated as potential sources of military jet fuels. Tar oil, produced at about 3200 barrels per day (BPD), is a highly aromatic lignite-pyrolysis liquid with a typical density of 1.01 and boiling range of about 220-975 F (104-524). Crude phenols, extracted from process water at about 900 BPD, is essentially a mixture of phenols, cresols, dihydric phenols, and naphthols, with an oxygen content averaging over 13 wt %. The naphtha is a low-boiling mixture extracted from syngas at about 725 BPD. Chief components are benzene, alkylbenzenes, sulfur compounds, and highly variable amounts of methanol, acetone, and methylethylketone. Based on these typical by-product characteristics, preliminary assessments were that the tar oil was the most-promising jet-fuel source, that crude phenols was a questionable source because of this high oxygen content, and that naphtha was a poor source because of its low-boiling range.

33040 (CONF-890666–1) **Gas separations using inorganic membranes.** Egan, B.Z.; Singh, S.P.N.; Fain, D.E.; Kidd, G.J.; Roettger, G.E.; White, D.E. Oak Ridge National Lab., TN (USA). 1989. 10p. Sponsored by DOE Fossil Energy. DOE Contract AC05-84OR21400. From Gasification and gas stream cleanup systems; Morgantown, West Virginia, USA; 27-30 Jun 1989. Order Number DE89013010/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The R&D program consists of developing, fabricating, and testing inorganic membrane separation systems for the recovery of H_2 and the separation of coal gasification gases. Major parts of the program include (1) assessment of the status of R&D activity related to gas separations using inorganic membranes; (2) identification and selection of candidate membrane materials, based on the chemistry of the separation environment and the availability and cost of the materials; (3) fabrication and characterization of candidate membranes using specialized techniques available at the Oak Ridge Gaseous Diffusion Plant; and (4) evaluation of the separations capability of the fabricated membranes in terms of permeabilities and fluxes of gases. This quarter, literature searches of several data bases were completed to compile information on the status of R&D on inorganic membranes for gas separations. A commercially available tubular alumina membrane was evaluated in terms of mean pore size, pore size distribution, and gas permeabilities of nitrogen, helium, and carbon dioxide. Several tubular alumina membranes were fabricated and characterized by pore size distribution measurements. The design of a test apparatus for measuring the gas permeabilities of membranes at high temperatures and pressures was completed. 2 figs., 3 tabs.

33041 (CONF-8711252–1) **Some thoughts on coal structure: implications of coal liquids characterization.** Winschel, R.A. Consolidation Coal Co., Library, PA (USA). Research and Development Dept. 1987. 17p. Sponsored by DOE Fossil Energy. DOE Contract AC22-84PC70018. From 1. EPRI workshop on coal structure; Monterey, California, USA; 4-5 Nov 1987. Order Number DE89013144/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Most of the work we have done at Consolidation Coal Company has not been directed at discerning coal structure. most of our work is in characterization of coal liquids; we have worked closely with Wilsonville, Lummus, H-Coal, the current HRI process, and some of the coprocessing development programs that are ongoing. Characterization of some coal liquids and correlations to coal structure is discussed. 11 figs.

33042 (CONF-8810170–, pp. 6-24) **Thoughts on direct liquefaction of coal.** Wender, I. (Univ. of Pittsburgh, PA (USA)). USDOE Pittsburgh Energy Technology Center, PA (USA). 1988. From DOE direct liquefaction contractor's conference; Pittsburgh, Pennsylvania, USA; 4-6 Oct 1988. In *Direct liquefaction contractors' review meeting. Proceedings.* Order Number DE89009225/JAW. Available from NTIS, PC A22/MF A01; 1.

The fuel market, worldwide, is large, interrelated and complex. The energy-rich US is steadily importing more and more oil. At present, the oil is comparatively cheap but no explanation is needed of the present and future danger of continuing this state of affairs. A large part of their response to the OPEC embargo was spent in developing methods for converting coal to clean fuels for the generation of electricity and for the production of transportation fuels. The two chief routes to these products involve the direct and the indirect liquefaction of coal. Conversion technology is available for the production of clean fuels and liquids by indirect methods although serious problems have evolved in some cases. Direct systems, however, went through the pilot stage and then, except for the Wilsonville plant, essentially disappeared. It gives one pause to realize that there are those who think they should abandon even this much-needed plant. One might even ask whether it was wise to bulldoze every large direct liquefaction plant that existed not so long ago. In the short time allowed, a number of questions will be raised; it is hoped that they will be useful and controversial. Are we endeavoring to extend the technology base put in place since the old German work in an evolutionary manner, or should we place greater emphasis on basic and applied research aimed at more revolutionary pathways in the conversion of coal? Are there ways of converting coal to liquids at temperatures below the coal pyrolysis temperature? There appear to be potentially valuable avenues of research or various product uses that are not being pursued at all or not as vigorously as warranted. Seeming failures may be either commercially successful in the future or will help prepare this country to provide fuels and chemicals for its upcoming needs.

33043 (CONF-8810170–, pp. 60-80) **HRI's DOE/multi-client co-processing research program.** Duddy, J.E. (Hydrocarbon Research, Inc., Lawrenceville, NJ (USA)). USDOE Pittsburgh Energy Technology Center, PA (USA). 1988. From DOE direct liquefaction contractor's conference; Pittsburgh, Pennsylvania, USA; 4-6 Oct 1988. In *Direct liquefaction contractors' review meeting. Proceedings.* Order Number DE89009225/JAW. Available from NTIS, PC A22/MF A01; 1.

HRI is conducting continued bench-scale research and development of Coal/Oil Co-Processing Technology under US Department of Energy and multi-client, international sponsorship. The objectives of this bench-scale research are to evaluate a number of alternative feedstock combinations (to better understand feedstock interactions) and to identify process improvements. To date, two runs have been completed on alternative feedstock combinations, and one process improvement run has been completed. This work has characterized the reactivity differences between Texas Lignite/Maya residuum and Westerholt coal/Cold Lake residuum, and identified low-temperature/

high temperature two-stage operation as a potential process improvement. Future work will include laboratory support activities to screen feedstocks, operating conditions, and catalysts, further bench-scale operations and engineering assessments of the research results.

33044 (CONF-8810170–, pp. 81-120) **Bench-scale co-processing.** Nafis, D.A. (UOP Inc., Des Plaines, IL (USA)); Gatsis, J.G.; Humbach, M.J. USDOE Pittsburgh Energy Technology Center, PA (USA). 1988. DOE Contract AC22-84PC70002;AC22-87PC79818. From DOE direct liquefaction contractor's conference; Pittsburgh, Pennsylvania, USA; 4-6 Oct 1988. In *Direct liquefaction contractors' review meeting. Proceedings.* Order Number DE89009225/JAW. Available from NTIS, PC A22/MF A01; 1.

A conceptual commercial plant design has been completed for a co-processing unit based on the results of bench-scale Run No. 19. Detailed engineering work was completed to provide the process flows, heat and weight balances and equipment selection information necessary to generate capital and operating costs. The estimated erected cost of a co-processing plant handling 25,875 BPSD of Lloydminster Vacuum Resid and 2450 MT/D of AR Illinois No. 6 Coal would be approximately $182 million. A refinery economic model was constructed containing the co-processing unit and downstream upgrading units. This model facilitated the economic analysis and optimization of the upgrading and blending operations needed to produce salable finished products from the intermediate co-processed products. At 1987 crude and finished product prices, the internal rate of return (IRR) on the investment for a refinery including a co-processing unit would be less than that for the same refinery without coal conversion capabilities. The co-processing refinery would, however, produce an additional 6850 BPSD of liquid products - 8628 BPSD more gasoline, but slightly less No. 2 fuel oil. At increased crude and product prices, the co-processing refinery becomes relatively more attractive. At a crude price of $35/bbl, the profits from the co-processing refinery would exceed those for a conventional refinery, and at $42/bbl, the IRR would exceed the 20% target rate of return on today's conventional refinery.

33045 (CONF-8810170–, pp. 25-59) **Economics of production of clean utility fuels and domestic oil supplies from high sulfur coals and residual oils.** Shannon, R.H. (Ohio Ontario Clean Fuels, Inc., Etobicoke (Canada)). USDOE Pittsburgh Energy Technology Center, PA (USA). 1988. From DOE direct liquefaction contractor's conference; Pittsburgh, Pennsylvania, USA; 4-6 Oct 1988. In *Direct liquefaction contractors' review meeting. Proceedings.* Order Number DE89009225/JAW. Available from NTIS, PC A22/MF A01; 1.

The US Department of Energy (DOE) and the Ohio Coal Development Office (OCDO) have signed agreements with Ohio Ontario Clean Fuels, Inc., to share in the cost of a $225 million facility that will convert a mixture of high sulfur coal and residual oil into clean-burning liquid fuels. The technology, known as Co-Processing simultaneously upgrades coal and heavy residual oil. The process is an innovation of commercial practiced conventional refining technology by which residual oil alone is upgraded. The facility will Co-Process 800 tons per day of high sulfur Ohio coal with 8675 barrels per day (BPD) of heavy crude oil. It will produce 4500 bpd of naphtha and 7250 bpd of distillate fuels, which can be used in transportation fuels, and in turbines, utility boilers or as additional feedstock and blending components at oil refineries. High conversion, over 90%, of the coal and heavy resid to clean fuels can be achieved. Over 5 barrels of quality petroleum products are produced from one ton of the blend of coal and oil. For each ton of coal in blend almost 5 barrels of petroleum products are recovered which is a significant increase from about three barrels recovered in the previous US coal liquefaction programs. Nitrogen and sulfur are recovered as valuable fertilizer by-products. Metals and particulates are removed from the coal and resid, and disposed of in a manner compatible with the environment. This paper describes the project and some of the results and economics of test work which has been conducted over four years in eight pilot plants.

33046 (CONF-8810170–, pp. 121-141) **Upgrading alternatives for Great Plains by-product liquids.** Masin, J. (Amoco Oil Co., Naperville, IL (USA)); Sault, L.; Tatterson, D.; Fox, J.; Furlong, M. USDOE Pittsburgh Energy Technology Center, PA (USA). 1988. From DOE direct liquefaction contractor's conference; Pittsburgh, Pennsylvania, USA; 4-6 Oct 1988. In *Direct liquefaction contractors' review meeting. Proceedings.* Order Number DE89009225/JAW. Available from NTIS, PC A22/MF A01; 1.

Amoco and Lummus Crest are engaged in a project to evaluate the production of jet fuel and other salable products from by-product liquids (tar oil, phenols, and naphtha) from the Great Plains Coal Gasification Plant in Beulah, North Dakota. As part of Task 1 of this project, a linear program has been developed which evaluates various upgrading alternatives. Currently the by-products streams are burned in the utility boilers and steam superheaters in the Great Plains plant. The linear program evaluates alternative processing routes, ranging from conventional refinery processes (for example, catalytic reforming, hydrotreating, and hydrocracking) to chemical processes such as Phenoraffin and Dynaphen. Preliminary economics have been developed for seven different upgrading schemes with product slates ranging from maximum production of jet fuel to a maximum profit case in which chemicals were the primary product. As the project continues, Amoco will produce jet fuel samples from the Great Plains liquids for further testing by the US Air Force and associated contractors and Lummus will further define the design of one of the processing schemes and its integration into the Great Plains plant.

33047 (CONF-8810170–, pp. 160-185) **Continuous coking tests under fluid coking conditions.** Riegel, H. (Lummus Crest Inc., Bloomfield, NJ (USA)); Stavropoulos, N.; Strangio, V.A. USDOE Pittsburgh Energy Technology Center, PA (USA). 1988. From DOE direct liquefaction contractor's conference; Pittsburgh, Pennsylvania, USA; 4-6 Oct 1988. In *Direct liquefaction contractors' review meeting. Proceedings.* Order Number DE89009225/JAW. Available from NTIS, PC A22/MF A01; 1.

LCI conducted ten coking tests with the bench scale continuous stirred coking unit (CSCU) with five coal liquefaction samples from Wilsonville and HRI. The CSCU is a fluid coking apparatus designed and constructed by LCI (based on Exxon Research and Engineering data). The coker distillate yield ranged from 31 to 76 wt% of the feed (on an ash free basis). The operating conditions were selected on the basis of batch bench tests and Exxon fluid coking tests. The coking yields were seen to be temperature dependent - the distillate product decreased while the gas and coke yields increased with increasing coking temperature. A comparison of these test results with batch tests conducted earlier by LCI, shows the distillate yields to be lower for CSCU tests. Comparison with Exxon test results shows similar distillate and coke yields, but higher gas yields for the CSCU tests. Analysis of the distillate products showed higher aromaticity and hydrogen donor transfer capability for coal liquefaction.

33048 (CONF-8810170–, pp. 230-239) **Impact of bottoms coking on two-stage direct liquefaction processes.** Tomlinson, G. (MITRE Corp., McLean, VA (USA)); Gray, D. USDOE Pittsburgh Energy Technology Center, PA (USA). 1988. From DOE direct liquefaction contractor's conference; Pittsburgh, Pennsylvania, USA; 4-6 Oct 1988. In *Direct liquefaction contractors' review meeting. Proceedings.* Order Number DE89009225/JAW. Available from NTIS, PC A22/MF A01; 1.

This paper evaluates the economic impact of using fluid coking as a method of bottoms upgrading and solids removal in two-stage liquefaction. The coking results used in the analysis were obtained from bench-scale tests conducted by Lummus-Crest on vacuum bottoms from the Wilsonville Two-Stage Liquefaction Unit. This analysis concludes that coking is at least competitive with Critical Solvent Deashing (CSD), and may offer significant economic advantages. Coking is also a simpler and more highly developed process than CSD and will be less sensitive to feedstock changes, and thus should be a more stable system in an integrated plant. It is recommended that further investigation of coking as a solid/liquid separation process be undertaken.

33049 (CONF-8810170–, pp. 240-265) **Recent progress at Wilsonville in the direct liquefaction of a low-ash Ohio No. 6 coal and a Texas lignite.** Gollakota, S.V. (Southern Electric International, Inc., Wilsonville, AL (USA)); Lee, J.M.; Davies, O.L.; Pinkston, T.E. USDOE Pittsburgh Energy Technology Center, PA (USA). 1988. DOE Contract AC22-82PC50041. From DOE direct liquefaction contractor's conference; Pittsburgh, Pennsylvania, USA;

4-6 Oct 1988. In *Direct liquefaction contractors' review meeting. Proceedings.* Order Number DE89009225/JAW. Available from NTIS, PC A22/MF A01; 1.

The results of the two most recent runs completed at the Wilsonville Advanced Coal Liquefaction R & D Facility are presented. In Run 254, a low-ash Ohio No. 6 bituminous coal was tested in catalytic-catalytic, close-coupled integrated mode using Shell 317 bimodal catalyst in both stages. This run has demonstrated the advantages of processing low-ash coals in terms of high liquid yields, low energy rejections, and high coal conversions, among others. The effects of space velocity, second-stage temperature, and process solvent composition on process performance and product yields are presented. The catalyst replacement rates required to maintain steady-state activity levels at all-distillate product slate are projected. These results are compared with those obtained previously with Illinois No. 6 coal. The impact of these advances on the economics of coal-derived liquid fuels is assessed. In Run 255, initial screening of operating conditions for the liquefaction of a Texas lignite was completed. A smooth startup operation was achieved by the use of a lignite + bituminous blend as initial coal feed. Iron oxide in combination with a sulfiding agent was effective as slurry catalyst for lignite conversion. The use of critical solvent deashing unit for separating the mineral matter and unconverted coal from resid, all three derived from lignite, was demonstrated for the first time. Amocat-1B, an experimental bimodal catalyst, was tested as a possible first-stage catalyst. Despite some operational problems, this run has provided guidelines for future process optimization tests with this low-rank coal. Finally, the ongoing work and the long-term objectives of the Wilsonville program are outlined.

33050 (CONF-8810170–, pp. 266-283) **Evolution of the catalytic two-stage liquefaction (CTSL) process.** Comolli, A.G. (Hydrocarbon Research, Inc., Lawrenceville, NJ (USA)); Johanson, E.S. USDOE Pittsburgh Energy Technology Center, PA (USA). 1988. From DOE direct liquefaction contractor's conference; Pittsburgh, Pennsylvania, USA; 4-6 Oct 1988. In *Direct liquefaction contractors' review meeting. Proceedings.* Order Number DE89009225/JAW. Available from NTIS, PC A22/MF A01; 1.

The Catalytic Two-Stage Liquefaction (CTSL) Process was conceived in 1983 based on some microautoclave tests and a short continuous bench run. A substantial reduction in bottoms viscosity and preasphaltene content versus the H-Coal Process and two-stage thermal catalytic processing was noted. Based on the promising results obtained from this two-stage close-coupled, low temperature/high temperature catalytic process, the Department of Energy provided the support necessary from 1983-1987 to develop the process. In this four year period yields have increased from 3.3 barrels of distillate/ton of M.A.F. coal to 5.0 barrels of distillate/ton of M.A.F. coal or a 50% overall increase in distillate liquid yield with a concurrent improvement in product quality. Because of the higher yield of better quality distillate, the cost per barrel of product has been decreased by over 20%. The series of developments leading to the present status of the CTSL Process are reviewed, as well as planned experiments designed to further improve yield and quality and process economics.

33051 (CONF-8810170–, pp. 284-310) **New CO/water conversion of coal.** Bianco, A.D. (Eniricerche S.p.A., Milan (Italy)); Girardi, E.; Stroppa, F. USDOE Pittsburgh Energy Technology Center, PA (USA). 1988. From DOE direct liquefaction contractor's conference; Pittsburgh, Pennsylvania, USA; 4-6 Oct 1988. In *Direct liquefaction contractors' review meeting. Proceedings.* Order Number DE89009225/JAW. Available from NTIS, PC A22/MF A01; 1.

This report describes the results of several coal liquefaction and upgrading experiments carried out with three different coals to compare the effectiveness of the CO/H_2O/base system in relation with the more conventional donor-solvent approach. The experimental data show that the CO/H_2O/base system converts medium and low rank coal to liquid products better than tetralin/H_2. The products from COSTEAM liquefaction have usually a lower etheroatoms content which is probably the reason of their different upgrading reactivity compared with products from tetralin/H_2.

33052 (CONF-8810170–, pp. 328-340) **Low severity conversion of activated coal.** Ross, D.S. (SRI International, Menlo Park, CA (USA)); Hirschon, A.S. USDOE Pittsburgh Energy Technology Center, PA (USA). 1988. DOE Contract AC22-87PC79936. From DOE direct liquefaction contractor's conference; Pittsburgh, Pennsylvania, USA; 4-6 Oct 1988. In *Direct liquefaction contractors' review meeting.* Order Number DE89009225/JAW. Available from NTIS, PC A22/MF A01; 1.

SRI is conducting research related to recent reports that brief hydrothermal treatment of coal leads to a material that is activated toward subsequent liquefaction and mild gasification. The authors had similarly observed liquefaction activation following hydrothermal pretreatment of Illinois No. 6 coal, with benefits arising from pretreatment at 250°C for periods as brief as 60 sec. There have in addition been several accounts of hydrothermal work with coals emphasizing compositional changes, but where the activation process was not considered. Zoeller et al, for example, recently described changes on the composition of an Ohio bituminous coal and a Texas lignite, and their report provides a good review of similar, earlier work. The study described here includes both aspects of hydrothermal pretreatment, including investigation of compositional and morphological changes, changes in the volatility of the coal, and liquefaction benefits. They conclude their discussion with some speculation on the reasons behind the activation towards the production of liquids.

33053 (CONF-8810170–, pp. 341-346) **Enhanced coal liquefaction by low-severity catalytic reactions.** Davis, A. (Pennsylvania State Univ., University Park (USA)); Derbyshire, F.J.; Schobert, H.H. USDOE Pittsburgh Energy Technology Center, PA (USA). 1988. From DOE direct liquefaction contractor's conference; Pittsburgh, Pennsylvania, USA; 4-6 Oct 1988. In *Direct liquefaction contractors' review meeting.* Order Number DE89009225/JAW. Available from NTIS, PC A22/MF A01; 1.

The general aims of this research program are to examine the potentials and limitations for improving the net conversion and product distribution during liquefaction of coals through temperature-staged catalytic reaction, in which the coal is converted in successive stages of increasing severity. It is believed that these gains are directly related to the modifications to the coal structure which occur in the first, low-severity stage. Through the use of an impregnated catalyst, in order to maximize contact with the coal, and reaction at low temperature, conditions are created in which there is limited thermolytic bond cleavage and hydrogenation reactions are favored, thus allowing closer control over the critical reactions which take place at the onset of coal liquefaction. Specific objectives of the research are to gain an understanding of the chemical reactions occurring during the low- and high-severity stages which lead to the observed gains in product distribution and composition; to elucidate the catalyst functions and mechanisms; and to determine the dependence of these processes upon coal rank and reaction conditions, since studies have already shown that the optimum conditions in the two stages are different for bituminous and subbituminous coals and that, even with catalyst present, the solvent composition can exert a strong influence on product distribution.

33054 (CONF-8810170–, pp. 347-362) **Serial biological conversion of coal into liquid fuels.** Liu, R.Q.; Johnson, N.L.; Magruder, G.C.; Ackerson, M.D.; Vega, J.L.; Clausen, E.C.; Gaddy, J.L. USDOE Pittsburgh Energy Technology Center, PA (USA). 1988. From DOE direct liquefaction contractor's conference; Pittsburgh, Pennsylvania, USA; 4-6 Oct 1988. In *Direct liquefaction contractors' review meeting.* Order Number DE89009225/JAW. Available from NTIS, PC A22/MF A01; 1.

Recently, several microorganisms have been shown to be capable of directly solubilizing low rank coals. This bioextract has a high molecular weight and is water soluble, but is not useful as a liquid fuel. This paper presents the results of studies to biologically solubilize coal and convert the solubilized coal into more useful compounds. Preliminary experiments have been conducted to isolate cultures for the serial biological conversion of coal into alcohols. Coal particles have been solubilized employing an isolate from the surface of Arkansas lignite. Natural inocula, such as sheep rumen and sewage sludge, are then employed in developing cultures for converting the bioextract into alcohols. This paper presents preliminary results of experiments in coal solubilization and bioextract conversion.

33055 (CONF-8810170–, pp. 391-416) **Low-severity liquefaction using a phenolic solvent.** Rindt, J.R. (Univ. of North Dakota Energy and Mineral Research Center, Grand Forks (USA)); Hetland, M.D.; Knudson, C.L. USDOE Pittsburgh Energy Technology Center, PA (USA). 1988. From DOE direct liquefaction contractor's conference; Pittsburgh, Pennsylvania, USA; 4-6 Oct 1988. In *Direct liquefaction contractors' review meeting.* Order Number DE89009225/JAW. Available from NTIS, PC A22/MF A01; 1.

This paper summarizes the most recent efforts at the UND Energy and Mineral Research Center (EMRC) associated with the development of a low-severity processing system which utilizes a phenolic solvent and a sodium promoter to solubilize the feed coal. Once soluble, the unconverted coal and ash are separated, producing a low-ash stream. This clarified stream is mixed with a partitioning solvent to produce a solid, low-moisture, low-ash product. After separation of the precipitated solid, the clarified solution of startup solvent, sodium additive, and partitioning solvent is distilled. The bottoms from this distillation are recycled as feed slurry solvent. The processes of separating the ash from the product slurry, precipitating the solids from the clarified product slurry, separation of the solids from the combined solution, and distillation to recover both the recycle solvent and the recycle partitioning solvent are collectively called the downstream processing loop. The phenolic solvent balance during this process has been demonstrated to be in excess of 100%. Conversion of the coal to phenol-soluble material has been demonstrated with several coals and with recycled solvent. The most current effort examines the relationship between the downstream processing loop and the product slate. Of particular interest are the effects of varied solids separation procedures and varied partitioning solvent ratios and admixtures on the general characteristics of the solid product.

33056 (CONF-8810170–, pp. 417-426) **Ionic hydrogenation using gaseous H_2.** Cheng, J.C. (Lehigh Univ., Bethlehem, PA (USA)); Larsen, J.W.; Maioriello, J. USDOE Pittsburgh Energy Technology Center, PA (USA). 1988. From DOE direct liquefaction contractor's conference; Pittsburgh, Pennsylvania, USA; 4-6 Oct 1988. In *Direct liquefaction contractors' review meeting.* Order Number DE89009225/JAW. Available from NTIS, PC A22/MF A01; 1.

The objectives of this study are: (1) To explore the ionic hydrogenation of low rank coals using H_2O:BF_3 as the acid and hydrogen gas as the hydride donor in the presence of catalytic quantities of transition metal complexes to activate hydrogen; and (2) To develop the optimum reaction conditions. A variety of ionic hydrogenation systems were screened using two test compounds in the search for effective acid/H_2/catalyst combinations. A new ionic hydrogenation system using H_2O:BF_3/H_2/$(CH_3CN)_2$ $PtCl_2$ was found to hydrogenate aromatics/polynuclear aromatics (PNAs) and to cleave C-O bonds. The reaction products were characterized using standard, appropriate techniques such as NMR, gas chromatography, mass spectrometry, and elemental analyses. The H_2O:BF_3/H_2/$(MeCN)_2PtCl_2$ system was applied to Wyodak coal in an attempt to develop efficient, near-room-temperature coal conversion chemistry. Results to date are discussed.

33057 (CONF-8810170–, pp. 427-438) **Coupled chemical and catalytic conversion a preliminary report on coal solubilization.** Stock, L.M. (Univ. of Chicago, IL (USA)); Chatterjee, K.; Ettinger, M.; Flores, F.; Miyake, M. USDOE Pittsburgh Energy Technology Center, PA (USA). 1988. From DOE direct liquefaction contractor's conference; Pittsburgh, Pennsylvania, USA; 4-6 Oct 1988. In *Direct liquefaction contractors' review meeting.* Order Number DE89009225/JAW. Available from NTIS, PC A22/MF A01; 1.

The investigation of a coupled chemical and catalytic conversion strategy for coal liquefaction has been under study during the past year. The concept is based on the idea that the structural disruption of the coal in one stage will augment the catalytic upgrading of the coal in the second step. O-Alkylation does not solubilize most coals to an adequate degree, but C-alkylation, in which the proton of a carbon acid is abstracted by a strong base to produce an anion that can be alkylated with a suitable alkyl halide is an attractive alternative. Ignasiak and coworkers demonstrated that, after the reaction was repeated three times, up to 14 ethyl groups per 100 carbon atoms could be introduced into an 83.2%C coal and that up to 64% of the ethylation product of an 87.3%C cal could be solubilized in chloroform. Several research groups have been intensively investigating C-alkylation reactions and have obtained disparate results. For example, Lazarov reported a clear correlation between coal rank and solubility, while Ignasiak found no such correlation. It seemed to the authors that the differences in the results might arise because of differences in procedures and reagents. Indeed, no report defining the most important experimental factors in coal solubilization has appeared for the C-alkylation reaction. Accordingly, they have systematically studied the influences of different reagents, i.e. the base and the solvent, and different conditions, i.e. the base concentration and the reaction temperature, on the conversion of a high ranking bituminous coal with a low oxygen content into soluble products. This choice was mandated by their desire to avoid O-alkylation as a factor in the reaction.

33058 (CONF-8810170–, pp. 439-456) **Intercrystalline anion exchange, sorption, and base catalysis.** Marcelin, G. (Univ. of Pittsburgh, PA (USA)); Kelkar, C.P. USDOE Pittsburgh Energy Technology Center, PA (USA). 1988. DOE Contract FG22-84PC70808. From DOE direct liquefaction contractor's conference; Pittsburgh, Pennsylvania, USA; 4-6 Oct 1988. In *Direct liquefaction contractors' review meeting.* Order Number DE89009225/JAW. Available from NTIS, PC A22/MF A01; 1.

The goal of this program has been to investigate the synthesis, characteristics, and properties of a class of materials, double-metal layered hydroxides, as a novel type of catalyst with solid base properties. Double-metal layered hydroxides are compounds similar in structure to the mineral hydrotalcite consisting of brucite-type layers ($Mg(OH)_2$) in which a portion of the divalent magnesium has been substituted by a trivalent cation in an octahedral coordination state, such as aluminum. Such substitution results in a mixed-metal hydroxide layer bearing a net positive charge which is balanced by the presence of anions in the interlayer. These materials can conceptualized as being the anionic analogs of cationic clays (such as montmorillonite). Thus, it should be feasible to prepare double metal layered hydroxides with strong basic anions in the interlayer (anions such as OH^-, O^{2-}, or NH_2_ in order to carry out base catalysis applicable to coal liquefaction processes. Results to date are discussed.

33059 (CONF-8810170–, pp. 465-475) **Novel approaches to catalysis in coprocessing and in the direct liquefaction of coal.** Herrick, D.E. (Univ. of Pittsburgh, PA (USA)); Wender, I.; Tierney, J.W. USDOE Pittsburgh Energy Technology Center, PA (USA). 1988. From DOE direct liquefaction contractor's conference; Pittsburgh, Pennsylvania, USA; 4-6 Oct 1988. In *Direct liquefaction contractors' review meeting.* Order Number DE89009225/JAW. Available from NTIS, PC A22/MF A01; 1.

The coprocessing of coal and petroleum residuum is investigated using transition metal carbonyls (TMC's) as catalysts. TMC's can be used as hydrogenation catalysts in two ways. At low temperatures (<200°C) they are active as homogeneous catalysts for the hydrogenation of polynuclear aromatics such as those found in coal. At conventional coal liquefaction temperatures (>400°C), the TMC precursor decomposes to form well-dispersed unsupported heterogeneous catalyst particles. In this study TMC's were used for low-temperature hydrogenation of the coal model-compound anthracene, demonstrating that hydrogenation of coal model compounds can be carried out at temperatures below 200°C. Future experiments will determine if this catalyst can hydrogenate coal at low temperatures. The use of TMC's as precursors to heterogeneous catalysts in higher temperature reactions has also been investigated. Coprocessing reaction studies using iron pentacarbonyl ($Fe(CO)_5$) have shown that the addition of as little as 0.5 wt% Fe increases conversions to 82% compared with 39% for the no-catalyst case. This large effect by such a relatively small amount of iron is presumed due to the high dispersion of the heterogeneous catalyst produced form the TMC precursor. Catalyst composition and dispersion were investigated using X-ray diffraction and scanning electron microscopy. Line broadening of the X-ray diffraction peaks indicated that the final form of the catalyst was pyrrhotite ($Fe_{1-x}S$) with crystallite sizes as small as 120Å.

33060 (CONF-8810170–, pp. 476-489) **Heteroatom-containing compounds during liquefaction.** Knudson, C.L. (Univ.

of North Dakota, Grand Forks (USA)); Aulich, T.R.; Sharma, R. US-DOE Pittsburgh Energy Technology Center, PA (USA). 1988. From DOE direct liquefaction contractor's conference; Pittsburgh, Pennsylvania, USA; 4-6 Oct 1988. In *Direct liquefaction contractors' review meeting.* Order Number DE89009225/JAW. Available from NTIS, PC A22/MF A01; 1.

Evidence of hydrogen exchange reactions and coal distillate product formation during coal liquefaction can be masked by the presence of complex organic liquefaction solvents that contain hundreds of different compounds. By completely deuterating the solvent and increasing the concentration of selected compounds, the fate of the selected compounds and the formation of coal distillate products can be observed using GC/MS analysis. Liquefaction conditions for coal in an aromatic anthracene oil solvent (A04) were set at 375°C for 1 hour, using a reducing gas mixture of CO-water and hydrogen sulfide. Tests were also performed using THF insolubles instead of coal, and using both undeuterated and deuterated solvent, to provide comparison data. Results to date are discussed.

33061 (CONF-8810170–, pp. 490-503) **Development of hydrous metal oxide catalysts for direct coal liquefaction.** Stohl, F.V. (Sandia National Labs., Albuquerque, NM (USA)); Dosch, R.G.; Stephens, H.P. USDOE Pittsburgh Energy Technology Center, PA (USA). 1988. DOE Contract AC04-76DP00789. From DOE direct liquefaction contractor's conference; Pittsburgh, Pennsylvania, USA; 4-6 Oct 1988. In *Direct liquefaction contractors' review meeting.* Order Number DE89009225/JAW. Available from NTIS, PC A22/MF A01; 1.

Improved efficiency in direct coal liquefaction processes could be realized if catalysts with better activity, selectivity and life were available. In previous research supported by the Department of Energy at Sandia National Laboratories, the properties and activities of catalysts prepared via hydrous metal oxide (HMO) ion exchangers were explored and found to have potential for application to a number of reactions associated with the conversion to coal to liquid fuels. The objective of this current work is to develop catalysts, based on hydrous titanium oxide (HTO) ion exchangers, for use in coal liquefaction processing. The ultimate goal of the program is an improved coal liquefaction catalyst produced in quantities that allow for testing in a large-scale process development unit such as the Advanced Coal Liquefaction R and D Facility at Wilsonville, Alabama.

33062 (CONF-8810170–4) **Recycle oils from fluid coking of coal liquefaction bottoms.** Winschel, R.A.; Burke, F.P. Consolidation Coal Co., Library, PA (USA). Research and Development Dept. 1988. 15p. Sponsored by DOE Fossil Energy. DOE Contract AC22-84PC70018. From DOE direct liquefaction contractor's conference; Pittsburgh, Pennsylvania, USA; 4-6 Oct 1988. Order Number DE89013142/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A series of ten fluid-coker tars from coal liquefaction vacuum bottoms, was characterized to evaluate their use as liquefaction recycle oils. The primary variables in the coking tests were temperature (1000 to 1200°F) and coker feedstock source. None of the tars produced at 1000°F or 1100°F were hydrotreated. Since the properties of those tars are different than those produced at 1200°F, they may respond differently to hydrotreating. However, the difference is such that the tars produced at lower temperature are more similar to their feedstock. Therefore, it is expected that their susceptibility to hydrotreating should be intermediate between their feedstock and the high-temperature coker tars. Based on these results, it would appear that tars produced from fluid coking of liquefaction vacuum bottoms can be recycled to a catalytic liquefaction reactor to produce additional liquids without adversely affecting process performance. 8 refs., 1 fig., 6 tabs.

33063 (CRIEPI-W–87044) **Development of moving bed desulfurization method.** Akiyoshi, H. (and others). Central Research Inst. of Electric Power Industry, Tokyo (Japan). 1988. vp. (In Japanese). Available from Central Research Inst. of Electric Power Industry, Tokyo (Japan).

We have been developing a technology of moving bed desulfurization that is a type of hot gas desulfurization for Integrated coal Gasification Combined Cycle (IGCC) power generation system. In this type the sorbent is regenerable iron oxide and used on cycle system (desulfurization and regeneration), and it is important that the sorbent is regenerated suitably after desulfurization. This paper describes regeneration characteristics and powdering of the sorbent in a recycle process, and the results were as follows: (1) the amount of consume O_2 in moles during regeneration is constant irrespective of inlet O_2 volume, and it is decided by the amount of inlet hydrogen sulfide during desulfurization; (2) the amount of produced SO_2 in moles during regeneration tends to increase with decrease of gas volume; (3) the powdering rate of the sorbent is about from 7 to 9 percent irrespective of rotary feeder load.

33064 (CRIEPI-W–87045) **The long-term reliability of desulfurization sorbent for hot coal gas desulfurization.** Shirai, H. (and others). Central Research Inst. of Electric Power Industry, Tokyo (Japan). 1988. vp. (In Japanese). Available from Central Research Inst. of Electric Power Industry, Tokyo (Japan).

High temperature desulfurization is necessary to achieve an IGCC power generation system with high thermal efficiency. Iron oxide desulfurization process of fixed bed is being researched and developed at Yokosuka Research Laboratory. Iron oxide sorbent of this process is used repeatedly. During desulfurization step, iron oxide is converted to iron sulfide. During the regeneration step, iron sulfide is returned to iron oxide by an oxidizing gas (O_2-SO_2-N_2 gas). But some of the iron sulfide remains as iron sulfide and the sulfur remains in the sorbent. This sulfur lowers the H_2S capacities of the sorbent. In the previous report, the relation between residual sulfur and regeneration conditions under atmospheric pressure was investigated. In this report, the relation between H_2S capacities and residual sulfur was investigated. The following results were obtained: (1) the residual sulfur lowers H_2S capacities, because this sulfur remains as iron sulfide; (2) the value of residual sulfur after regeneration increases and H_2S capacities decrease in the early desulfurization-regeneration cycles. But these values become stable according to the increase of cycling number; (3) the decrease of H_2S capacities in the early cycles is not affected by the increase of residual sulfur, and depends on any unconfirmed factor.

33065 (DOE/MC/24267–2665) **Literature survey results: Topical report.** Willson, W.G.; Ness, R.O.; Hendrikson, J.G.; Entzminger, J.A.; Jha, M.; Sinor, J.E. North Dakota Univ., Grand Forks, ND (USA). Energy and Mineral Research Center; AMAX Research and Development Center, Golden, CO (USA); Sinor (J.E.) Consultants, Inc., Niwot, CO (USA). Jan 1988. 106p. Sponsored by DOE Fossil Energy. DOE Contract AC21-87MC24267. Order Number DE89000942/JAW. Available from NTIS, PC A08/MF A01 - OSTI; GPO Dep.

This report reviews mild gasification processes with respect to processing conditions and configurations. Special emphasis was placed on processes which could be commercialized within five years. Detailed market information was provided by J.E. Sinor concerning markets and economic considerations of the various processing steps. Processing areas studied include coal cleaning; mild gasification; and upgrading of the char, condensables, and hydrocarbon gases. Pros and cons in the different processing areas as well as "gaps" in pertinent data were identified and integrated into a detailed process development program. The report begins with a summary of the market assessment and an evaluation of the co-product. The impacts of feed materials and operating parameters–including coal rank, heating rate, pressure, agglomeration, temperature, and feed gas composition–on the co- products and processes were evaluated through a literature survey. Recommendations were made as to the preferred product specifications and operating parameters for a commercial plant. A literature review of mild gasification processes was conducted and evaluated with regard to product specification and operating parameters. Two candidate processes were chosen and discussed in detail with respect to scale-up feasibility. Recommendations were then made to process development needs to further consideration of the two processes. 129 refs., 33 figs., 16 tabs.

33066 (DOE/PC/63032–T19) **Bench-scale development of the gravimelt process for cleaning coal: Final report.** TRW Space and Technology Group, Redondo Beach, CA (USA). Applied Technology Div. Aug 1987. 199p. Sponsored by DOE Fossil Energy. DOE Contract AC22-83PC63032. Order Number DE89009052/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The objectives of this project are to perform preliminary bench-scale testing, design, construction, shakedown and operation of a 20 lbs of coal per hour modular test circuit to demonstrate the feasibility of the Gravimelt (Molten-Caustic-Leaching) technology for producing coal that meets New Source Performance Standards (NSPS). This is to be accomplished while processing three coals representative of the Eastern United States coal production. The coal seams selected were Pittsburgh No. 8, Kentucky No. 11 and Middle Kittanning. Bench-scale tests for regeneration, filtration and rector type were performed to obtain design data for scale-up 20 lbs of coal per hour. On the basis of this data, a modular test circuit was constructed and each unit was operated on a sequential but not simultaneous basis. Coal was produced with sulfur content well under the New Source Performance Standards and with equipment performance consistent with commercial design requirements. An assessment of the results indicates that the next step in bench-scale testing should be the installation of multiple stages of countercurrent washing capability which will allow real-time linkage of the modules for long-term steady state operation. 52 figs., 56 tabs.

33067 (DOE/PC/79808–T1) **Deactivation of hydrotreatment catalysts used for coal liquids: Semi-annual report, November 12, 1988–May 11, 1989.** Dadyburjor, D.B. West Virginia Univ., Morgantown, WV (USA). Dept. of Chemical Engineering. 1989. 12p. Sponsored by DOE Fossil Energy. DOE Contract FC22-88PC79808. Order Number DE89013513/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Coal liquid hydrotreatment catalysts deactivate rapidly due to deposition of coke and metals inside the pores of the catalyst particles. The deactivation can be due to the gradual choking of the catalyst pores and/or due to the suppression of active sites on the catalyst. The objective of the proposed work is to determine which of these two mechanisms of deactivation is predominant, and this is done by using the Constant Deactivation Arrhenius Plot (CDAP) technique. The inertness of the solvent (m-Xylene) was checked over Co-Mo/Al_2O_3 (Houdry HR-801) and Ni-Mo/Al_2O_3 (Shell 324M) catalyst. This test was carried out at or near extreme conditions to be employed for further experiments. In order to test the accuracy of the results obtained from the continuous flow reactor unit, rate constants obtained for the HDS of thiophene over fresh Co-Mo/Al_2O_3 (Houdry HR-801) were compared with those obtained by Froment et al. over Co-Mo/Al_2O_3 catalyst (Procatalyse HR 306) under the same reaction conditions. Tests were also carried out to determine if the catalyst needed to be pre-sulfided before every reaction run at each temperature or if it was sufficient to pre-sulfide the catalyst only once. 1 ref., 3 figs., 7 tabs.

33068 (DOE/PC/79815–T1) **Biotechnology of indirect liquefaction: Progress report, April 1–June 30, 1988.** Datta, R.; Grethlein, H.; Jain, M.; Worden, M.; Zeikus, J.G. Michigan Biotechnology Inst., Lansing, MI (USA). 1988. 35p. Sponsored by DOE Fossil Energy. DOE Contract AC22-88PC79815. Order Number DE89014652/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This project on indirect liquefaction of coal derived synthesis gas will focus on two stage anaerobic bioconversion. The first stage will address bioconversion of synthesis gas (CO, H_2/CO_2) to volatile fatty acids by a CO adapted strain of Butyribacterium methylotrophicum. The second stage will address bioconversion of fatty acids to combustible solvents – acetone butanol and ethanol by a strain of Clostridium acetobutylicum. The project began at MBI when the final contract was awarded on March 17, 1988. The initial tasks of the project are: Task Ia – develop chemostat fermentation for syngas conversion by B. methylotrophicum and Task 2a – produce biocatalysts (C. acetobutylicum) for second stage solvent-fuel synthesis. A multidisciplinary team of microbiologists and engineers has been put together to work on this project. Both tasks are progressing well. 5 refs., 4 figs., 1 tab.

33069 (DOE/PC/79928–T7) **Solid superacids as coal liquefaction catalysts: Quarterly report, January–March 1989.** Tierney, J.W.; Wender, I. Pittsburgh Univ., PA (USA). Dept. of Chemical and Petroleum Engineering. 1989. 8p. Sponsored by DOE Fossil Energy. DOE Contract FG22-87PC79928. Order Number DE89012586/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This research is aimed at exploring the possibility of mild coal liquefaction in the presence of solid superacids, especially oxides of iron, titanium, zirconium, and hafnium mixed with sulfate ions. Fe_2O_3/SO_4^{2-} has been shown to be an impressively active catalyst in coal conversion at 400°C. Our objective is to find conditions under which Fe_2O_3/SO_4^{2-} and similar systems catalyze the conversion of coal at mild conditions of temperature and pressure. So far, Fe_2O_3/SO_4^{2-}, TiO_2/SO_4^{2-}, ZrO_2/SO_4^{2-}, and HfO_2/SO_4^{2-} catalysts have been synthesized and characterized by XRD, BET, IR, acidity measurement, and sulfur analysis. In addition, a comparison of the relative reactivity of these superacids for n-pentane conversion in both batch and fixed bed reactor systems has been carried out. Investigations of the hydrocracking of model compounds, including diphenyl ether and diphenylmethane, was initiated in this quarter. Improvements in methods of synthesis of these acids have been achieved and improved reaction systems and methods of reducing catalyst deactivation are under study. Samples of Fe_2O_3/SO_4 have been sent for Moessbauer study; the other solid acids will be examined by EXAFS. 4 refs., 2 tabs.

33070 (DOE/PC/88810–1) **Development of analytical procedures for coprocessing: Quarterly technical progress report for the period October 1–December 31, 1988.** Vogh, J.W.; Anderson, R.P. National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA). 1988. 16p. Sponsored by DOE Fossil Energy. DOE Contract AC22-88PC88810. Order Number DE89013801/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This is the initial quarterly technical report for a project designed to extend our understanding of coprocessing reactions. More specifically, this research is concerned with development of chemical analytical procedures needed to distinguish between materials and compound classes in the coprocessing products which are derived from the petroleum resid, the coal, or both. This project will provide new information of the structure of products derived from coprocessing and will aid in identification of the reaction mechanisms that affect conversion. Carbon isotope ratios have been used to determine the relative contributions of coal and resid to various coprocessing fractions where the fractions were produced by distillation or solubility fractionation. In the current project, the carbon isotope technique will be utilized with chemical compound type fractionations which have been developed at NIPER. These comprehensive separation schemes have been extensively applied to petroleum but not to coprocessing products. These separation techniques will be used initially with coprocessing samples produced in-house with a 2-liter batch autoclave. 8 refs., 5 figs., 1 tab.

33071 (DOE/PC/88811–T1) **Fundamental reaction pathways during coprocessing: Quarterly status and milestone report.** Stock, L.M.; Gatsis, J.G.; Ceylan, Kadim; Ofosu-Asante, Kofi. US-DOE Pittsburgh Energy Technology Center, PA (USA). 31 Dec 1988. 8p. Sponsored by DOE Fossil Energy. DOE Contract AC22-88PC88811. Order Number DE89014655/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Reaction pathways of coprocessing of coal and petroleum are being investigated. This quarter, the O-alkylation reaction and hydrogen transfer in coal liquefaction were investigated. 2 refs., 2 tabs. (CBS)

33072 (DOE/PC/88812–T2) **Process and analytical studies of enhanced low severity co-processing using selective coal pretreatment: Quarterly technical progress report, December 1988–February 1989.** Baldwin, R.M.; Miller, R.L. Colorado School of Mines, Golden, CO (USA). Dept. of Chemical Engineering and Petroleum Refining. 1989. 16p. Sponsored by DOE Fossil Energy. DOE Contract AC22-88PC88812. Order Number DE89011372/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This report describes progress on research during the second quarter of this contract dealing with applications of coal pretreatment techniques in coal hydroliquefaction by co-processing. The objectives of the project are to investigate various coal pretreatment techniques, such as mild alkylation, and to determine the effect of these pretreatment procedures on the reactivity of the coal. Reactivity enhancement will be evaluated under both direct hydroliquefaction and co-processing conditions. Research during the past quarter focused on development of techniques that will be used to assess the degree of chemical modification of the coal

achieved by the various pretreatment procedures. A preliminary investigation of techniques for determination of the degree of alkylation by carbon balance was carried out, with mixed results. The primary emphasis of the research was in development of methods required to analyze coal samples using photoacoustic FTIR. Several PAS/FTIR spectra on coals of different rank (both parent and alkylated) were obtained. 14 figs.

33073 (DOE/PC/88813–T2) **A solid-state NMR study of condensation/retrograde reactions during coal liquefaction: Quarterly progress report, January 1, 1989–March 31, 1989.** Miknis, F.P. Western Research Inst., Laramie, WY (USA). Apr 1989. 10p. Sponsored by DOE Fossil Energy. DOE Contract AC22-88PC88813. Order Number DE89012591/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The objective of this work is to perform an NMR study of the aromaticity in coals, coal derived products and/or model compounds generated by pyrolysis and thermal solubilization of coal in the presence of a hydrogen donor solvent. Cross Polarization with Magic-Angle Spinning (CP/MAS) will be used to measure the carbon aromaticity, and Combined Rotation and Multiple Pulse Spectroscopy (CRAMPS) NMR techniques will be used to measure the hydrogen aromaticity. From these NMR measurements the aromatic hydrogen-to-carbon ratio will be obtained and used to study condensation/retrograde reactions during coal liquefaction. 8 refs., 2 tabs.

33074 (DOE/PC/88814–T2) **Fundamental studies of retrograde reactions in direct liquefaction: Second quarterly report, January 1–March 31, 1989.** Serio, M.A.; Solomon, P.R.; Bassilakis, R.; Kroo, E. Advanced Fuel Research, Inc., East Hartford, CT (USA). 1989. 12p. Sponsored by DOE Fossil Energy. DOE Contract AC22-88PC88814. Order Number DE89013515/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Results of the experiments in this proposed program will lead to an improved mechanistic understanding of retrograde reaction mechanisms in liquefaction, that can be used to explore improved process concepts designed to minimize retrograde reactions and, thus, to improve liquefaction yields. Work performed during this quarter can be summarized as follows: Direct polymerization of eugenol and p-allylphenol were accomplished. The resulting polymers had number-average molecular weights in the desired range. Demercuration of the product polymers was achieved in some of the cases; the three coals were ion exchanged to remove alkali metal cations; characterization of the three ion-exchanged Argonne coals by TG-FTIR and SEM/x-ray analysis was begun; a single microreactor consisting of a S.S Tube with flat flange ends was developed at AFR; some preliminary work was done on assessing the application of a network model which can predict coal fluidity (recently developed at AFR under separate funding) to the modeling of coal liquefaction. 4 figs.

33075 (DOE/PC/88817–T1) **A novel concept for high conversion of coal to liquids: Progress report No. 1, September 1–November 30, 1988.** Wiser, W.H.; Shaptai, J. Utah Univ., Salt Lake City, UT (USA). Dept. of Fuels Engineering. Dec 1988. 4p. Sponsored by DOE Fossil Energy. DOE Contract AC22-88PC88817. Order Number DE89014657/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

COAL LIQUEFACTION; PROGRESS REPORT; PLANNING; CONSUMPTION RATES; HYDROGEN; ECONOMICS

33076 (DOE/PC/88817–T2) **A novel concept for high conversion of coal to liquids: Progress report No. 2, December 2, 1988–February 28, 1989.** Wiser, W.H.; Shabtai, J. Utah Univ., Salt Lake City, UT (USA). Dept. of Fuels Engineering. Mar 1989. 4p. Sponsored by DOE Fossil Energy. DOE Contract AC22-88PC88817. Order Number DE89014656/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The overall objective of this work is to demonstrate conversion of coal to produce at least 70% by weight of the coal as liquids, with ratios of liquids to gases in excess of 10/1, resulting in low hydrogen consumption and a significant reduction in the cost of producing hydrocarbon liquid fuels from coal. Utilizing a small continuous-flow reactor designed and constructed for this research, the maximum possible ratio of liquids to gases will be defined, operating at short residence times of a few seconds, at the same time converting more than 70% of the carbon in the coal to liquids. The practical ability to attain coal particle center-line temperatures of 500°C in one second or less, using hot hydrogen gas in turbulent flow, will also be demonstrated. Particle heat-up rates for a few selected system pressures and particle sizes will be determined. Catalysts will be screened and selected for sufficient activity and selectivity to achieve the desired yields, with potential for operation within satisfactory economic boundaries as to cost, recoverability and regeneration. Particle heat-up rates for small coal particles slurried in a supercritical hydrocarbon-type fluid will be examined, using hot hydrogen gas in turbulent flow as the heat transfer medium.

33077 (DOE/PC/90538–11) **Use of basic nitrogen to chemically clean coal: Quarterly report no. 9 for the period March 15, 1989 to June 15, 1989.** Silver, H.F. Wyoming Univ., Laramie, WY (USA). Dept. of Chemical Engineering. 15 Jun 1989. 5p. Sponsored by DOE Fossil Energy. DOE Contract FG22-86PC90538. Order Number DE89013781/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Studies of the interaction of m-cresol and basic nitrogen compounds on coal desulfurization were continued. Mild coal liquefaction runs were made using 4-di-methylaminopyridine (DMAP), m-cresol, and coal derived distillates in varying concentrations. A series of non-promoted experiments were also conducted for comparison. Results indicate increasing the temperature from 600°F to 700°F significantly increases sulfur removal and pyridine conversion. DMAP and m-cresol concentration does not affect sulfur removal. However, the addition of DMAP increases pyridine conversion for the lignite and subbituminous coals but does not affect the bituminous coal. M-cresol has no effect on pyridine conversion. The interaction between DMAP and m-cresol is found to be insignificant. 2 tabs.

33078 (EUR–11729-DE) **Determining the density distribution in a 7 metre coke oven. Doctoral thesis, Clausthal Technical University - 2 appendices.** Lorson, H. (comp.). Commission of the European Communities, Luxembourg (Luxembourg). 1988. 158p. (In German). Available from Commission of the European Communities, Luxembourg.

This is the second part of the report, and contains 2 appendices. The first is a doctoral thesis entitled 'Basic investigations for the measurement of local and temporal density changes in a coke oven charge'. It describes calibration of the probe described in the first part of this report. The probe was calibrated in relation to the measurement volume taking account of oven chamber geometry and the effect of moisture and density changes brought about by the increasing carbonisation. The second appendix describes the results of the initial analysis of the coke-oven density distribution measurement taken using the probe. These show that: the apparent density at the beginning of the carbonisation stage is a dynamic quantity which increases sharply during the first hour of the residence time; the height-dependent density distribution which then sets in remains for the most part constant in qualitative terms (up to 40% of the residence time); the water content is not constant at the different height levels but adjusts itself according to the density distribution; the charging process does not always provide reproducible density distributions.

33079 (EUR–11843) **Progress in synthetic fuels.** Imarisio, G.; Bemtgen, J.M. (eds.). Commission of the European Communities, Luxembourg (Luxembourg). 1988. 279p. (CONF-8806366–: 1. contractors' meeting on the results of the subprogramme 'production and utilization of new energy vectors', Saarbruecken, Germany, F.R., 6-8 Jun 1988). Available from European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037.

Papers presented at a seminar which discusses the present status of the technologies involved in the use of synthetic fuels and the advances that have been achieved through the European Community R & D programme. Sessional headings include: catalysis; direct liquefaction and process technology; modelling and system studies; industrial plants. Relevant papers are abstracted separately.

33080 (EUR–11843, pp. 9-18) **New small granulometry catalysts and new methodologies to study the direct liquefaction of coal.** Bacaud, R. (Universite Claude Bernard Lyon, Villeurbanne

(France). Institut de Recherches sur la Catalyse); Besson, M.; Brodski, D.; Bussiere, P.; Cagniant, D.; Cebolla-Burillo, V.; Charcosset, H.; Djega-Mariadassou, G.; Jamond, M.; Nickel, B.; Oberon, M. Centre National de la Recherche Scientifique, 69 - Villeurbanne (France). Inst. de Recherches sur la Catalyse. 1988. (CONF-8806366–: 1. contractors' meeting on the results of the subprogramme 'production and utilization of new energy vectors', Saarbruecken, Germany, F.R., 6-8 Jun 1988). In *Progress in synthetic fuels.* Available from European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037.

With respect to the direct liquefaction of coal, a report is given of:- some new iron catalysts proposed in the literature, - the main catalytic mechanisms considered up to now in particular the effects of a very small granulometry of Fe_2O_3 and of the coke deposits on the resulting iron sulfide. A new autoclave is then described with heating rate < 70 degrees C min^{-1}, cooling rate 60 degrees C min^{-1}, level of temperature regulation +0.5°C or -0.5°C. It is shown that multi stage liquefaction (sulfidation of Fe_2O_3 stage at 300 degrees C, hydrogenation of solvent (and coal) stage at 400 degrees C, hydroliquefaction stage at 450 degrees C with high heating rate between the different stages) gives higher conversion of coal into oils than a single stage-low heating rate operation. The results are interpreted in terms of (i) a different deactivation of the iron sulfide catalyst according to the thermal treatment, (ii) a possible formation of insoluble products by radical polymerization reaction. Those reactions may be prevented by in situ formation or by addition of hydroaromatics. 32 refs., 2 figs., 2 tabs.

33081 (EUR–11843, pp. 19-31) **Improved hydrotreating catalysts through optimized active phase-support interaction.** Moulijn, J.A. (University of Amsterdam (Netherlands). Inst. of Chemical Technology); Tajik, S.; Mangnus, P.J.; Scheffer, B.; Beer, V.H.J. de; Bouwens, S.M.A.M.; Eijsbouts, S. Amsterdam Univ. (Netherlands). Inst. of Chemical Technology. 1988. (CONF-8806366–: 1. contractors' meeting on the results of the subprogramme 'production and utilization of new energy vectors', Saarbruecken, Germany, F.R., 6-8 Jun 1988). In *Progress in synthetic fuels.* Available from European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037.

A concept for the active phase-support interaction which is based on the study of the hydrotreating catalysts, Co, Ni, Mo, and W is presented. This concept is verified by measuring HDS activity and applying Temperature-Programmed Sulfiding (TPS), and EXAFS/XANES of the catalysts supported on alumina, silica, and carbon. It is shown that hydrotreating catalysts which have lower active phase-support interaction, exhibit higher HDS activity. 5 refs., 10 figs.

33082 (EUR–11843, pp. 32-39) **Selective catalysts for coal and heavy oil hydrogenation.** Schulz, H. (Universitaet Karlsruhe (Germany, F.R.). Engler-Bunte-Institut); Rahman, N.M.; Schuhmann, G. Karlsruhe Univ. (T.H.) (Germany, F.R.). Engler-Bunte-Inst. 1988. (CONF-8806366–: 1. contractors' meeting on the results of the subprogramme 'production and utilization of new energy vectors', Saarbruecken, Germany, F.R., 6-8 Jun 1988). In *Progress in synthetic fuels.* Available from European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037.

It is initially being defined in this paper, which selectivity of coal and heavy oil conversion is most desirable. The desired selectivity is then related to individual reaction steps in the polystep reaction mechanism and respective catalyst specific activities, CoMoS-Al_2O_3, NiMoS-Al_2O_3, NiWS-Al_2O_3 and Fe-catalysts are compared for HDS, HDO, HDN and aromatic ring hydrogonation. The influence of hydrogen partial pressure is shown to affect individual HDO-reaction steps differently. The reaction mechanisms thus change with changing hydrogen partial pressure. The HDO-reaction network is evaluated in detail for benzofuran and dibenzofuran and a very high structure sensitivity is being observed. The work is regarded as a basis for the development of 'selective catalysts' for coal and heavy oil hydrogenation. 34 refs., 7 figs., 12 tabs.

33083 (EUR–11843, pp. 40-48) **Development and characterization of new HDS catalysts and selection of coal liquefying operating conditions for catalysts screening.** Legarreta, J.A. (Escuela de Ingenieros de Bilbao (Spain)); Arias, P.L.; Fierro, J.L.G.; Marco, I.; Cambra, J.F. Escuela de Ingenieros de Bilbao (Spain). 1988. (CONF-8806366–: 1. contractors' meeting on the results of the subprogramme 'production and utilization of new energy vectors', Saarbruecken, Germany, F.R., 6-8 Jun 1988). In *Progress in synthetic fuels.*

Several alumina supported HDS catalysts were prepared by multistep impregnation: a conventional CoMo/Al_2O_3 catalyst and a series of new catalysts with acidified support (fluorine contents from 0 to 2 wt%) and Zn as second promoter. The catalysts were characterized by XPS, determining element dispersion on the alumina support. Hydrodesulphurization tests with thiophene in a continuous laboratory reactor were carried out at 300, 325, 350 and 375 degrees C. HDS activities, expressed as percent conversion of thiophene, and hydrogenation activities, measured by the butanes/butenes ratio in the products, were both determined by gas chromatography. Possible correlations between activities and characteristics of the catalysts were sought. A series of coal hydroliquefaction experiments were carried out in a 250 ml. stirred autoclave using a high volatile subbituminous coal. The liquefaction products were fractionated by soxhlet extraction using pentane, toluene and THF. The influence of operating conditions on liquefaction yields was explored varying time, temperature, pressure and amount and type of solvent. Tetralin, hexadecane and mixtures of both solvents were used. Some catalysts (CoMo/Al_2O_3; CoZnMo/Al_2O_3 and Fe_2O_3) were experimented on liquefaction with different operating conditions, trying to find out the most appropriate ones for catalysts screening. 12 refs., 2 figs., 7 tabs.

33084 (EUR–11843, pp. 49-57) **Hydroprocessing of coal derived middle distillates and studies of coal liquefaction potential.** Chadwick, D. (Imperial College of Science and Technology, London (United Kingdom). Dept. of Chemical Engineering and Chemical Technology); Kandiyoti, R.; Kershenbaum, L.S.; Kouyionas, V.; Gibbins-Matham, J.R. Imperial Coll. of Science and Technology, London (UK). Dept. of Chemical Engineering and Chemical Technology. 1988. (CONF-8806366–: 1. contractors' meeting on the results of the subprogramme 'production and utilization of new energy vectors', Saarbruecken, Germany, F.R., 6-8 Jun 1988). In *Progress in synthetic fuels.*

The effect of nitrogen- and oxygen-containing compounds on the hydrogenation of middle distillates from hydrocracking of coal extract liquids is being investigated. Results have been obtained for the hydrogenation of tetralin to decalin over a commercial Ni-Mo catalyst. The presence of low concentrations of quinoline causes a large decrease in hydrogenation activity while dibenzofuran has only a relatively minor effect. Preliminary results indicate that there is negligible interaction between these deactivation processes. The design of a novel swept-bed coal liquefaction reactor is also described. This uses a flow of solvent (tetralin) to remove products rapidly from the heated reaction zone. Preliminary data to show the performance of the computer-controlled heating system are presented, together with a description of the first trial with a coal sample. 7 figs., 4 tabs.

33085 (EUR–11843, pp. 68-72) **New hydrogen donors for direct liquefaction of coal.** Giuffre, L. (Politecnico, Milano (Italy). Departimento di Chimica Industriale); Tempesti, E.; Zanderighi, L.; Girelli, A.; Modica, G. Politecnico Milano (Italy). Dipt. di Chimica Industriale. 1988. (CONF-8806366–: 1. contractors' meeting on the results of the subprogramme 'production and utilization of new energy vectors', Saarbruecken, Germany, F.R., 6-8 Jun 1988). In *Progress in synthetic fuels.*

The use of tetralin and similar H-donor solvents in the hydroconversion of coal to liquid fuels is well known and is important in large-scale coal conversion processes. In an attempt to further reduce the severity of the reaction conditions generally used the overall performances of new donor solvents (ketones or esters) in the presence of typical Lewis acid catalysts (ZnO, Sb_2O_3, $A1C1_3$, B_2O_3, Fe_3O_4 and MgO) are now being investigated. The present study has thus been undertaken to develop better understanding of the role of the Lewis acid catalyst in promoting the direct liquefaction of coal at sub-pyrolysis temperatures. 8 refs.

33086 (EUR–11843, pp. 97-103) **Extraction of coal by hydrogenation.** Ben-Nasr, H. (Fried. Krupp GmbH, Essen (Germany, F.R.). Forschungsinstitut). Krupp (Friedr.) G.m.b.H., Essen (Germany, F.R.). Forschungsinstitut. 1988. (CONF-8806366–: 1.

contractors' meeting on the results of the subprogramme 'production and utilization of new energy vectors', Saarbruecken, Germany, F.R., 6-8 Jun 1988). In *Progress in synthetic fuels.*

At Krupp's central research establishment, development work is being carried out on a continuous extraction process for coal using supercritical water as solvent. The hydrogenating and hydrolysis properties of supercritical water promise high extraction yields. To allow continuous extraction it is necessary to develop an air-lock coal feeding and discharge system acting against the high process pressure. An air lock that was successfully tested at pressures up to 200 bar is described and the experience gained outlined. The results of initial batch tests are outlined. 3 figs., 2 tabs.

33087 (EUR–11843, pp. 81-88) **Catalyst development for selective conversion of syngas to mainly aromatic hydrocarbons - apparatuses and preliminary experiments.** Papp, H. (Ruhr-Universitaet Bochum (Germany, F.R.). Lehrstuhl fuer Technische Chemie); Baerns, M. Ruhr-Univ., Bochum (Germany, F.R.). Lehrstuhl fuer Technische Chemie. 1988. (CONF-8806366–: 1. contractors' meeting on the results of the subprogramme 'production and utilization of new energy vectors', Saarbruecken, Germany, F.R., 6-8 Jun 1988). In *Progress in synthetic fuels.*

The description of a high pressure apparatus for syngas experiments is given. The whole apparatus is controlled by a mini computer, to be able to work at constant CO conversion or at constant space velocity. For surface analysis an AES/XPS/ISS apparatus has been additionally equipped with a reaction chamber to conduct 'in situ' syngas experiments. The pressure dependence of selectivity and activity of an Fe/Mn oxide catalyst is reported. A maximum in activity is observed at a syngas pressure of 1.5 MPa. The surface concentration as determined by XPS and ISS of the catalysts is strongly altered by pretreatment conditions and the addition of Cu or K. 22 refs., 6 figs., 3 tabs.

33088 (EUR–11843, pp. 113-121) **Co-processing of residual petroleum fractions with a UK bituminous coal.** Bartle, K.D. (Heriot-Watt University, Edinburgh (United Kingdom). Dept. of Chemistry); Flynn, T.; Kemp, W.; Steedman, W.; Taylor, N.; Wallace, S. Heriot-Watt Univ., Edinburgh (UK). Dept. of Chemistry. 1988. (CONF-8806366–: 1. contractors' meeting on the results of the subprogramme 'production and utilization of new energy vectors', Saarbruecken, Germany, F.R., 6-8 Jun 1988). In *Progress in synthetic fuels.*

A U.K. bituminous coal (84.1% C; 5.2% H; 7.9% O) has been coprocessed with a set of five petroleum residues of varied composition under conditions simulating the extraction stage of two-stage coal liquefaction. The aim of the work is to test the feasibility of replacing a coal-derived solvent with a petroleum-derived solvent in the extraction stage. The petroleum solvents used consisted of two atmospheric and three vacuum residues. These have been extensively characterized and shown to vary widely in their structural properties. Optimum coal extraction rates were obtained at a coprocessing temperature of 410 degrees C and coal: solvent ratios of between 1:3 and 1:1. Coal conversions, measured as quinoline-soluble material, varied from 16.6% to 37.4%. The coal-petroleum interaction was enhanced by a high carbon aromaticity value in the petroleum solvent, but no simple correlations between solvent structure and extraction efficiency have as yet been identified. 3 refs., 6 figs., 4 tabs.

33089 (EUR–11843, pp. 122-130) **Liquefaction at low severity conditions, catalysed depolymerization of coal as a pretreatment for coal liquefaction.** Mastral, A.M. (Instituto de Carboquimica, Zaragoza (Spain)); Membrado, L.; Rubio, B. Instituto de Carboquimica, Zaragoza (Spain). 1988. (CONF-8806366–: 1. contractors' meeting on the results of the subprogramme 'production and utilization of new energy vectors', Saarbruecken, Germany, F.R., 6-8 Jun 1988). In *Progress in synthetic fuels.*

The possibility of using coal depolymerization as a beneficial pretreatment in coal liquefaction was tested (in a related preliminary work) over a Spanish lignite from Utrillas (Teruel), which was successively depolymerized and hydrogenated at mild conditions. Using depolymerization conditions previously described in the literature (BF_3, PTS and $AlCl_3$ as catalysts and Anisole, Phenol and Tetralin as solvents) and mild hydrogenation conditions (temperatures in the 300-320 C range, $FeSO_4$ as catalyst and two different hydrogenation media: cyclohexane and cyclohexane-2% tetralin mixture), the results showed that depolymerization improved in fact the extract yield of the global process when matched with suitable hydrogenation conditions. Extract yields in the 60-70% range were reached for the most active depolymerization reactions when coupled to hydrogenation in cyclohexane-2% tetralin; showing an important increase when compared both with the depolymerization only and hydrogenation only processes. The present research project plans to extend this work to less expensive depolymerization and more classical hydrogenations, using $ZnCl_2$-Toluene depolymerization and tubing bomb, 400 C, molybdenum sulfide catalysed, dry hydrogenation. 9 refs., 5 figs., 4 tabs.

33090 (EUR–11843, pp. 136-145) **The evaluation of cokes as filter aids in direct coal liquefaction.** Pass, R. (Bergbau-Forschung GmbH, Essen (Germany, F.R.)); Romey, I. Bergbau-Forschung G.m.b.H., Essen (Germany, F.R.). 1988. (CONF-8806366–: 1. contractors' meeting on the results of the subprogramme 'production and utilization of new energy vectors', Saarbruecken, Germany, F.R., 6-8 Jun 1988). In *Progress in synthetic fuels.*

The aim of this work is to show that filter aids for the filtration of coal liquefaction products can be prepared from feed coal and filtration residues. Recycling of filtration residues can save at least part of expensive raw materials. It was found that low-temperature fluidized bed carbonization can be used to produce carbonaceous filter aids for filtration in LSE-type, direct coal liquefaction. For the production of the filter aid a low-temperature fluidized bed carbonizer at Bergbau-Forschung is being used. The products are tested in a laboratory filter. 7 figs., 2 tabs.

33091 (EUR–11843, pp. 146-153) **The evaluation of cokes as filter aids in direct coal liquefaction.** Kimber, G.M. (British Coal Corporation, London (United Kingdom)). British Coal, London (UK). 1988. (CONF-8806366–: 1. contractors' meeting on the results of the subprogramme 'production and utilization of new energy vectors', Saarbruecken, Germany, F.R., 6-8 Jun 1988). In *Progress in synthetic fuels.*

One of the major problems experienced in the development of filtration for coal liquefaction was the rapid blinding of fine metal filter screens. Tests have shown that the screens could be cleaned in-situ and the frequency of such cleaning could be reduced by using precoats. Standard diatomaceous precoats could be used but these are expensive and their use could reduce the thermal value of the filter cake. Various carbonaceous products derived from coal and petroleum have been suggested as alternatives. Nine different samples of coke have been assessed in laboratory tests. All gave a good performance and effected considerable protection for metal screens against blinding. When used in plant tests the petroleum coke fines effected a doubling of interval between in-situ cleaning (sluicing) and was resistant to particle breakdown during slurry recycle. 1 ref., 5 figs., 1 tab.

33092 (EUR–11843, pp. 183-194) **Development of computer models for the simulation of coal liquefaction processes.** Williams, B.C. (University of Ulster, Coleraine (United Kingdom). Centre for Energy Research); McMullan, J.T. Ulster Univ., Coleraine (UK). Centre for Energy Research. 1988. (CONF-8806366–: 1. contractors' meeting on the results of the subprogramme 'production and utilization of new energy vectors', Saarbruecken, Germany, F.R., 6-8 Jun 1988). In *Progress in synthetic fuels.*

This suite of programs is designed to run on IBM PC and compatible machines, and the C programming language is used throughout. The system is 'user friendly' and requires no programming expertise, only a knowledge of the process to be modelled. The program 'compound' is used to prepare and maintain a compound physical and chemical property database. The programs 'layout' and 'techinfo' are the first stages in the evaluation of a new process and prompt the user for information which would normally be available on a process flow diagram. The mass and energy balance is calculated using the program 'balance' and two further programs 'utility' and 'costs' then calculate the utility usages and the capital cost. Within the thermodynamic subroutines the Lee and Kesler modification of the BWR equation of state is the only equation of state which

is used, and there is as yet no allowance for non-ideal solution behaviour. These are seen as areas of weakness, but the program's strength lies in its flexibility and modular construction, which allow the system to be easily modified to overcome its weaknesses. The testing of the program is restricted due to the lack of good data on coal liquids and liquefaction processes. 8 refs., 5 figs., 1 tab.

33093 (EUR–11843, pp. 195-204) **The development of a computer package for the calculation of direct coal liquefaction process economics.** Topper, J.M. (British Coal Corporation, London (United Kingdom)); Cross, P.J.I.; Goldthorpe, S.H.; Rule, J.D. British Coal, London (UK). 1988. (CONF-8806366–: 1. contractors' meeting on the results of the subprogramme 'production and utilization of new energy vectors', Saarbruecken, Germany, F.R., 6-8 Jun 1988). In *Progress in synthetic fuels.*

Process flowsheeting evaluations and parallel economic assessment studies can provide a cost-effective means of guiding research and development effort into advanced coal utilisation processes such as direct liquefaction. Developments in the capabilities of personal computers have meant that studies on complex processes can now be carried out without recourse to expensive mainframe computing facilities. Of particular value to research into coal utilisation processes would be computer software which enables process and economic studies to be carried out interactively on personal computer equipment, and British Coal is developing such software under contract to the Commission. This paper reviews progress to date on the work carried out. It describes the basic objectives and requirements of the subject software package and outlines the software architecture design which has been developed in order to meet these requirements. The key features which will be available for process and economic studies using the package are outlined, and the major tasks which will be undertaken during the next phase of the work programme are discussed. 6 figs., 2 tabs.

33094 (EUR–11843, pp. 104-112) **Coprocessing of Spanish lignites: main objectives and preliminary work.** Fabregat, A. (Universitat de Barcelona, Tarragona (Spain). Departament d'Enginyeria Quimica i Bioquimica); Salvado, J.; Giralt, J.; Moros, A.; Font, J.; Giralt, F. Barcelona Univ., Tarragona (Spain). Dept. d'Enginyeria Quimica i Bioqumica. 1988. (CONF-8806366–: 1. contractors' meeting on the results of the subprogramme 'production and utilization of new energy vectors', Saarbruecken, Germany, F.R., 6-8 Jun 1988). In *Progress in synthetic fuels.*

The main objective of this study is to determine the coprocessing temperatures and specific catalysts that yield maximum conversion and optimal product distribution for two Spanish lignites (Bergueda and Utrillas). Preliminary experimental results are presented and those obtained at optimal conditions will be adjusted to a kinetic model. 5 refs., 6 figs., 4 tabs.

33095 (EUR–11843, pp. 205-217) **Liquid fuels by indirect liquefaction of coal: process identification and assessment.** Bridgwater, A.V. (Aston University, Birmingham (United Kingdom). Energy Research Group); Anders, M. Aston Univ., Birmingham (UK). Energy Research Group. 1988. (CONF-8806366–: 1. contractors' meeting on the results of the subprogramme 'production and utilization of new energy vectors', Saarbruecken, Germany, F.R., 6-8 Jun 1988). In *Progress in synthetic fuels.*

The purpose of the project is to identify and evaluate indirect coal conversion processes for liquid fuel production from coal, in order to identify the more promising technologies and R&D needs as a strategic planning aid to the European Community. The project will share a common methodology with a parallel biomass conversion project and the computer model developed for the biomass project will be adapted to include indirect coal conversion. A large number of gasification processes have been identified and classified according to reactor type, status and stage of development. Many of these processes that were developed during the last twenty years have since been abandoned, whilst new processes are currently being developed up to commercial status. This paper presents the findings to date of the survey of gasification processes being performed and an overview of indirect coal liquefaction technologies. 58 refs., 5 figs., 6 tabs.

33096 (EUR–11843, pp. 224-229) **Saarberg/GfK coal liquefaction developments.** Wuerfel, H.E. (GfK Gesellschaft fuer Kohleverfluessigung mbH, Saarbruecken (Germany, F.R.)). Gesellschaft fuer Kohleverfluessigung m.b.H., Saarbruecken (Germany, F.R.). 1988. (CONF-8806366–: 1. contractors' meeting on the results of the subprogramme 'production and utilization of new energy vectors', Saarbruecken, Germany, F.R., 6-8 Jun 1988). In *Progress in synthetic fuels.*

In the course of the development work towards direct coal liquefaction, Gfk has developed a new hydrogenation process. In this process the coal is conveyed through the reactor from the top to the bottom, meeting the hydrogen in a counterflow. Among others some of the remarkable features of this process are a relatively high oil yield, a low hydrogen consumption, low pressure and a low energy demand. Furthermore, for particular areas of application, GfK has extended the new counterflow hydrogenation process by a subsequent coking stage for hydrogenation residues. In this two-stage so-called 'PYROSOL' process, the coal undergoes mild hydrogenation in the first stage, where pressure and reaction temperature may be correspondingly low. The process is particularly suited for the hydrogenation of coals with high ash contents. Both process stages have been successfully tested in the bench scale. 7 refs., 3 figs., 2 tabs.

33097 (EUR–11843, pp. 232-241) **The Krupp Koppers Prenflo process for coal gasification.** Wetzel, R.E. (Krupp Koppers GmbH (Germany, F.R.)). Krupp-Koppers G.m.b.H., Essen (Germany, F.R.). 1988. (CONF-8806366–: 1. contractors' meeting on the results of the subprogramme 'production and utilization of new energy vectors', Saarbruecken, Germany, F.R., 6-8 Jun 1988). In *Progress in synthetic fuels.*

High-temperature gasification of coal provides a clearly defined raw gas with main constituents carbon monoxide and hydrogen, which can be worked up, using conventional gas treatment techniques, to synthesis gas, hydrogen for hydrogenation processes, reduction gas and fuel gas. Krupp Koppers developed the PRENFLO process for the gasification of coal under pressure on the basis of the commercially proven Koppers-Totzek process for the gasification of coal dust at low pressure using pure oxygen. The key development phase, the demonstration of the long-term availability of the PRENFLO system and its components in a pilot plant with a throughput of 48 t/day coal dust, has reached technical status that justifies the planning and construction of a 1200 t/day PRENFLO module. The particular economic appeal for power plant concepts with integrated PRENFLO gasification gives rise to expectations that the first industrial application of this process will be in the field of power generation from coal. 9 figs., 3 tabs.

33098 (LBL–25911) **Fundamental studies of catalytic gasification: Annual report, October 1, 1987–September 30, 1988.** Heinemann, H.; Somorjai, G.A. Lawrence Berkeley Lab., CA (USA). Oct 1988. 16p. Sponsored by DOE Fossil Energy. DOE Contract AC03-76SF00098. Order Number DE89012849/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

In the past this program has investigated the role of catalysts in relatively low temperature steam gasification. New mechanisms have been demonstrated and it has been shown that combinations of alkali hydroxide with transition metal oxides form compounds which act as the true catalyst to produce mostly hydrogen and carbon dioxide. This has further been confirmed by surface science studies and by transmission electron microscopy. At the lower temperatures (~800 K) used, hydrogen and CO_2 are the products formed, but the effect of temperature and of the exact composition of the NiO/KOH catalyst that has been studied in the greatest detail on the CO_2/CO ratio remains to be defined. Similarly, a clear definition of the advantages of different alkali-transition metal oxide compositions is required. In addition to the previously reported gasification results of a lignite (N. Dakota), a subbituminous (Rosebud) and bituminous (Ohio Pitt No. 8) char, an additional bituminous char (Kentucky No. 13) has been evaluated for steam gasification after impregnation with either K-Ca or K-Ni oxides. An analysis of this char is presented in comparison with two of the other chars. 8 figs., 3 tabs.

33099 (LBL–26424) **Fundamental studies of catalytic gasification: Quarterly report, October 1, 1988–December 31, 1988.** Heinemann, H.; Somorjai, G.A. Lawrence Berkeley Lab., CA (USA). Dec 1988. 20p. Sponsored by DOE Fossil Energy. DOE Contract

AC03-76SF00098. Order Number DE89013413/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A controlled atmosphere electron microscopy (CAEM) study was completed for the steam gasification of graphite catalyzed by KOH/CaO. This permits comparison with the earlier CAEM study with K/Ni catalysts. Studies of controlled atmosphere electron microscopy, poisoning of demineralized char, and chemical intermediates during gasification are discussed. 17 figs., 1 tab.

33100 (LBL–26891) **Fundamental studies of catalytic gasification: Quarterly report, January 1, 1989–March 31, 1989.** Heinemann, H.; Somorjai, G.A. Lawrence Berkeley Lab., CA (USA). Mar 1989. 25p. Sponsored by DOE Fossil Energy. DOE Contract AC03-76SF00098. Order Number DE89012834/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This program has investigated the role of catalysts in relatively low temperature steam gasification. New mechanisms have been demonstrated and it has been shown that combinations of alkali hydroxide with transition metal oxides form compounds which act as the true catalyst to produce mostly hydrogen and carbon dioxide. Most of the mechanistic work has been done with graphite as a pure source of carbon. A number of chars with different ash contents and ash compositions have been gasified at relatively low temperatures (~800K). There is a major effect of the ash content on the catalyst. In some cases catalysts are being rapidly deactivated by ash components while in other cases gasification is promoted by ash. Demineralized chars can be gasified at low temperature with the potassium-nickel catalyst without appreciable deactivation. More recently it has been found that combinations of alkali and earth alkali catalysts, for instance mixtures of potassium and calcium oxides, are excellent gasification catalyst that cannot easily be poisoned by ash components. These catalysts are also considerably less expensive than transition metal compound containing materials. 12 figs., 2 tabs.

33101 (ORNL/Sub–83-43346/03) **Thermochemical stability diagrams for condensed phases and tabulation of volatile species over condensed phases for thirteen metal-oxygen-silicon systems at 1000 and 1250 K: Volume 2: Final report.** Gulbransen, E.A.; Meier, G.H. Oak Ridge National Lab., TN (USA); Pittsburgh Univ., PA (USA). Dept. of Materials Science and Engineering. 31 Jan 1989. 89p. Sponsored by DOE Fossil Energy. DOE Contract AC05-84OR21400. Order Number DE89014788/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

Thermochemical stability diagrams for oxide and silicide phases in mixed oxidation and silicide forming reactions are useful for the interpretation of the high temperature oxidation reactions which occur. In addition an analysis of the volatile metal and oxide species which develop at the several interfaces are useful in a complete analysis of high temperature oxidation. This work begins with a literature survey of the high temperature oxidation of metal silicides. The major part of the report is a description of the stability diagrams and the volatile species in the Ca-O-Si, C-O-Si, Fe-O-Si, Mn-O-Si, Mo-O-Si, Ni-O-Si, Nb-O-Si, Ta-O-Si, Ti-O-Si, V-O-Si, W-O-Si and Zr-O-Si systems. The importance of forming a SiO_2(s) film, the volatility of metal and oxide species, the melting points of the condensed phases and the formation of SiO(g) are discussed with regard to the high temperature oxidation of the metal silicides. 37 refs., 16 figs., 19 tabs.

33102 (PB–89-142608/XAB) **Fundamentals of coal-char chemistry. Final report, February 1985-April 1988.** Stein, S.E. West Virginia Univ., Morgantown, WV (USA). Dept. of Chemistry. Sep 1988. 273p. Available from NTIS, PC A12/MF A01.

See also PB–87-225926.

The principal objective of the program was to identify key chemical steps in conversion of coal to char. Studies examined model chemical systems and idealized structures based on the present knowledge of the structures and reactions of coal. Special attention was given to effects of substituents. Three general types of studies were undertaken; elementary rate measurement, mechanistic and theoretical. Rate constants for single-step processes were measured to aid both the establishment of mechanisms and the extension of results to other systems. Mechanistic studies established characteristic pathways for reactions leading towards growth and condensation of selected structural units. Hydrocarbon reactions were free radical in nature, with rates depending on H-transfer rates. Polyhydroxyaromatic molecules reacted through an entirely different mechanism with rates depending on trace inorganic constituents. Theoretical studies focused on properties of very large, well-defined, large polycyclic aromatic networks, structures that cannot be individually synthesized or studied experimentally, but which are thought to be present in char. The work provides a framework for applying classical physical organic concepts to reactions of very large coal-related structures.

33103 (PB–89-148829/XAB) **Design and economics of a plant to convert eastern bituminous coal to pipeline gas or power using KRW gasifiers with in-bed desulfurization. Topical report, November 1987-September 1988.** Earley, P.I.; Smelser, S.C. Fluor Technology, Inc., Irvine, CA (USA). Dec 1988. 151p. Available from NTIS, PC A08/MF A01.

See also PB–88-211990.

A first-pass design and cost estimate were prepared for a coproduction plant to convert eastern bituminous coal alternately to pipeline gas or power using KRW gasification with in-bed desulfurization. The direct-methanation process and other gas-processing units convert syngas into pipeline gas, or a combined-cycle power plant consumes the syngas to make power. The coproduction plant produces daily peaking power on weekdays and pipeline gas during nights and weekends. The coproduction of pipeline gas and daily peaking power in one gasification facility is competitive with a separate daily peaking power plant and a separate pipeline gas plant. If the daily peaking power can be sold at a premium price, the cost of producing pipeline gas is reduced.

33104 (VTT-SYMP–83, pp. 37-52) **Gasification combined cycle power generation - process alternatives.** Kurkela, E. (Secretaria de Asentamientos Humanos y Obras Publicas, Mexico City (Mexico)). Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). 1988. (CONF-8711302–: Seminar on pressurized fluidized bed combustion and gasification power systems, Espoo, Finland, 23-24 Nov 1987). In *Pressurized fluidized bed combustion and gasification systems.* Order Number DE89766970/JAW. Available from NTIS (US Sales Only), PC A13/MF A01.

Interest in Integrated Gasification Combined Cycle (IGCC) power plants has recently increased also in Finland. The IGCC systems offer the potential of superior efficiency and environmental performance over conventional pulverized coal or peat fired boilers. Potential applications are both large-scale electricity production from coal and medium-scale combined heat and electricity production. In the latter case, the gasification process should also be applicable to peat and wood. Several IGCC processes have been developed in USA and in Europe. These processes differ from each other in many respects. Nearest to commercialization are processes, which employ oxygen gasification and cold gas cleanup. The Cool Water plant, which was brought into operation in 1984 in USA, has demonstrated the feasibility of an IGCC system using Texaco entrained-bed gasifier. Several pressurized fluidized-bed and fixed-bed gasification processes have also reached a pilot or demonstration stage with a wide variety of coals from lignite to hard coal. Pressurized fluidized-bed gasification of peat (Rheinbraun-HTW-process) will also be demonstrated at the peat ammonia plant of Kemira Oy, which will be commissioned in 1988 in Oulu, Finland. Oxygen gasification and cold gas cleanup are, however, economically viable only in large-scale applications. Technology is being developed to simplify the IGCC system, in order to reduce its capital costs and increase its efficiency. Air gasification combined with ho gas cleanup seems to have a great potential of improving the competitiveness of the IGCC system.

33105 (VTT-SYMP–83, pp. 161-192) **Rheinbraun HTW-gasification technology for combined cycle power generation.** Nitschke, E. (UHDE GmbH, Dortmund (Germany, F.R.)). Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). 1988. (CONF-8711302–: Seminar on pressurized fluidized bed combustion and gasification power systems, Espoo, Finland, 23-24 Nov 1987). In *Pressurized fluidized bed combustion and gasification systems.* Order Number DE89766970/JAW. Available from NTIS (US Sales Only), PC A13/MF A01.

One of the most advanced coal gasification processes is the Rheinbraun HTW-fluidized bed gasification. The process has been developed by Rheinische Braunkohlenwerke AG, Cologne, in close

cooperation with Uhde GmbH as the engineering partner. In 1978 a pilot plant (capacity up to 30 t/d) was put into operation. The influence of different gasification parameters on the performance of the plant was studied. Also Finnish peat an Australian lignite with a high sulphur and salt content were tested. Based on the results a commercial scale demonstration plant with a capacity of 720 t/d dried lignite was built and is successful in operation since 1986. Together with Rheinbraun and Kraftwerk-Union Uhde has performed as study for an IGCC-plant (600 MW), based on HTW-process. The concept has great advantages with respect to efficiency. Also emissions from the power station can be drastically reduced.

33106 (VTT-SYMP–83, pp. 199-212) **Techno-economic evaluation of different gasification combined cycle processes.** Solantausta, Y. Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). 1988. (CONF-8711302–: Seminar on pressurized fluidized bed combustion and gasification power systems, Espoo, Finland, 23-24 Nov 1987). In *Pressurized fluidized bed combustion and gasification systems.* Order Number DE89766970/JAW. Available from NTIS (US Sales Only), PC A13/MF A01.

The economic and technical potential of Integrated Gasification Combined Cycle (IGCC) with peat was studied in order to compare presently available IGCC to conventional power production, and to assess the future potential of a developed IGCC. The features typical of peat-based IGCC were assessed. The effects of the most significant process variables on the overall efficiency were studied. Three process concepts were compiled and their material and energy balances were calculated. Investment and operating costs were estimated, and power production costs for condensing power at 150 MW were compared. The production price of electricity with the present IGCC is competitive with that of conventional power plants. However, its efficiency is higher, 43% compared to 37% (LHV-based). The emissions from the IGCC are only a fraction of those from a pulverized fuel boiler. The future IGCC concept proved to be very promising. The efficiency would be as high as 50% and the production cost of electricity close to FIM 150/kWh, compared to FIM 180/kWh for the conventional technology.

33107 (VTT-SYMP–83, pp. 193-197) **Pressurized bed peat gasification plant of Kemira Oy in Oulu.** Kuorelahti, K. (Kemira Oy, Oulu (Finland)). Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). 1988. (CONF-8711302–: Seminar on pressurized fluidized bed combustion and gasification power systems, Espoo, Finland, 23-24 Nov 1987). In *Pressurized fluidized bed combustion and gasification systems.* Order Number DE89766970/JAW. Available from NTIS (US Sales Only), PC A13/MF A01.

Kemira, the largest chemical enterprise in Finland, is building a pressurized bed peat gasification for producing synthesis gas. The gas will be used for ammonia and other chemicals. The ammonia production will be 80,000 tons/year. The investment costs amount to 225 million FIM. The production is to be started in spring 1988.

33108 (VTT-SYMP–83, pp. 213-235) **Hot gas cleanup: the state-of-the-art and prospects in the future.** Clift, R. (University of Surrey (UK)). Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). 1988. (CONF-8711302–: Seminar on pressurized fluidized bed combustion and gasification power systems, Espoo, Finland, 23-24 Nov 1987). In *Pressurized fluidized bed combustion and gasification systems.* Order Number DE89766970/JAW. Available from NTIS (US Sales Only), PC A13/MF A01.

In addition to sulphur compounds, turbine expansion gases in PFBC and gasification cycles contain particulates, alkali salts and HC1. Gas cleaning is most economic if carried out hot. During periods of steady operation, cyclones can reduce particle loading in PFBC plant to a level acceptable to a gas turbine. However, periodic upsets in cyclone performance could destroy a turbine. Moreover, cyclone performance in gasification plant is less well investigated. Therefore, in either application, some form of tertiary gas cleanup is needed. Wet scrubbing is not feasible, and sonic agglomeration is questionable. Electrostatic precipitation is potentially usable but unproven for PFBC, and very doubtful for gasification. Metal and ceramic fabric filters are not sufficiently durable. Rigid ceramic barrier filters appear to be the best developed option for tertiary cleaning, either as candles or crossflow monoliths. Granular bed filters need further evaluation, but offer potential advantages of steady operation and compact design, with to possibility of collecting gases and particulates in one device. The extent to which alkali salts represent a problem depends on chlorine levels in the coal: high-chlorine coals are subject to more alkali release, and the alkalis are harder to remove by gettering.

33109 **Controlling mechanisms for gasification of pulverized coal.** Smoot, L.D. (Brigham Young Univ., Provo, UT (US)); Brown, B.W. v.v of The Combustion Institute joint conference: Western states and Japanese sections (Extended Abstracts). Combustion Institute, Pittsburgh, PA (1988). (CONF-871118–: Combustion Institute joint fall meeting: Western states and Japanese sections, Honolulu, Hawaii, USA, 22-25 Nov 1987).

Controlling mechanisms for fuel-rich reaction of pulverized coal with oxygen at atmospheric pressure were investigated through analysis of experimental, laboratory-scale gasification data and by comparison with predictions of a comprehensive model. Gasification data for four coal types were considered at various oxygen/steam/coal ratios, while coal feed rate, particle size, and flame type (premixed, diffusion) were also investigated. Model predictions for each test variable are compared with observations. From these observations and predictions, possible controlling mechanisms are suggested.

33110 **Chemical cleaning of coal by molten caustic leaching after pretreatment by low-temperature devolatilization.** Chriswell, C.D. (Iowa State University, Ames (USA). Ames Laboratory, Fossil Energy Program); Shah, N.D.; Kaushik, S.M.; Markuszewski, R. *Fuel Processing Technology (Netherlands),* 22(1): 25-39 (Apr 1989).

During chemical cleaning of coal by molten caustic leaching (MCL), which can remove over 95% of the ash-forming minerals and up to 90% of the sulfur from coal, unwanted carbonate by-products are formed which result in the loss of coal carbon, significant consumption of expensive caustic, and subsequent filtration problems during the reprocessing of spent caustic solutions. Present work shows that carbonate levels can be reduced by 70% when using a pretreatment of the coal prior to MCL, combined with the rigorous exclusion of air during the pretreatment and leaching. The pretreatment consists of partial devolatilization of coal at 420-450 C for about 15 minutes under nitrogen purge to remove oxygen-containing compounds from coal. MCL treatment of the devolatilized coal under an oxygen-free atmosphere resulted in removals of coal ash and sulfur comparable to those obtained under normal MCL conditions without these modifications. The yield of clean coal was reduced slightly, but this was more than compensated for by an increased heat content of the product coal and by the recovery of energy-rich gases and liquids evolved during pretreatment. Preliminary results show that formation of carbon dioxide by the water shift reaction is not a significant source of carbonate: in fact, steam purging of the reactor may lead to further reductions in the formation of carbonate. 13 refs., 3 figs., 7 tabs.

33111 **Influence of steam pretreatment on coal composition and devolatilization.** Khan, M.R. (USDOE Morgantown Energy Technology Center, WV); Chen, W.-Y.; Suuberg, E. *Energy and Fuels (USA),* 3(2): 223-230 (Mar-Apr 1989).

Previous studies have shown that pretreating coal with steam can enhance the liquid yields during coal pyrolysis. The objective of this research was to characterize steam- and helium-treated coals to better understand the effects of pretreatment on pyrolysis-produced yield and composition. Pretreated samples were pyrolyzed in rapid and slow heating rate reactors. The following characterization techniques were used to analyze the products: elemental analysis, Fourier transform infrared spectroscopy, gas chromatography/mass spectrometry, and cross-polarization/magic angle-spinning ^{13}C nuclear magnetic resonance spectroscopy. This research demonstrated that steam treatment of a low-rank coal reduces the concentration of methoxy, phenolic, and aliphatic carbonyl and carboxyl groups in the coal. The low-rank coal showed significant reductions in total oxygen concentration after steam treatment, but the high-rank coals showed unchanged or even higher oxygen content. After steam pretreatment, phenols were the major components found in the water used. Pretreatment with steam increased the aromaticity of Wyodak coal. Steam treatment did not enhance total volatile yields from vacuum pyrolysis for any of the coals. Low-rank

coals showed increases in tar yields when pyrolyzed at a rapid rate after steam treatment, but these increases seemed to be at the expense of total volatiles yield. When steam-treated coal was devolatilized at a slow heating rate, no increase in tar yield was observed for either a low- or a high-rank coal. 17 refs., 4 figs., 9 tabs.

33112 **Investigation of liquefaction mechanisms with molecular probes.** Bockrath, B.C. (USDOE Pittsburgh Energy Technology Center, PA); Schroeder, K.T.; Smith, M.R. *Energy and Fuels (USA)*, 3(2): 268-272 (Mar-Apr 1989).

Coal conversion in the presence of a petroleum resid solvent has been investigated by using 1,3-dimethylnaphthalene and decalin as mechanistic probes. Total free radical activity, as measured by the decalin isomerization, increases with added coal or resid. In the case of an Illinois No. 6 coal and a Maya atmospheric tower bottom, the total radical activity of some mixtures is greater than expected from a simple sum of effects. Hydrogen atom activity, as measured by the demethylation of dimethylnaphthalene, also increases with added coal or resid. Of the four fossil-derived materials studied, Illinois No. 6 coal produces the most selective hydrogen atom donors. 12 refs., 7 figs., 2 tabs.

33113 **Development of an extractive continuous monitor for hydrogen chloride (HCl) analyses of coal-derived process streams.** Huston, G.C. (Morgantown Energy Technology Center, WV (USA)); Wachter, J.K. *Analytical Letters (USA)*, 22(1): 269-292 (1989).

An HCl monitor has been developed at the Morgantown Energy Technology Center (METC) for the extractive analysis of high-temperature/high-pressure, coal-derived process streams. This monitor is capable of HCl concentration measurement in the presence of all known coal gasification products. Detection is based on the ability of HCl to protonate a high boiling alcohol (solvent) and, thus, enhance the conductivity of the alcohol. Conductivity is then related to HCl concentration. The observed high degree of sensitivity that can be achieved is a result of analyte preconcentration prior to the conductivity measurement due to the apparently fast dissolution rate of HCl into the alcohol solvent coupled with a large analyte gas-to-solvent ratio. The linear dynamic range of the HCl monitor is two orders of magnitude. However, since the degree of preconcentration can be adjusted by changing either the solvent or analyte gas flow rate, the HCl monitor has an extended operating range of six orders of magnitude (ppb lower limit, percentage upper limit). The practical lower detection limit for the HCl monitor is estimated to be 50 ppbv. Precision is good with typical relative average deviations of about three parts per hundred. Although the HCl monitoring method was originally designed for the analysis of gasification process streams, the system can be adapted for use with a variety of process gas streams.

0105 By-products

Refer also to citation(s) 33046, 33104, 33195

0106 Properties

Refer also to citation(s) 33038, 33041, 33051, 33072, 33073, 33135, 33138, 33345, 34362

33114 (ARC–1989, pp. 11) **Changes in the physical structure of coal on partial solubilization.** Parkash, S. (Alberta Research Council, Edmonton, Canada); Moschopedis, S.E. Alberta Research Council, Edmonton, AB (Canada). [1989]. (CE–02438). In *Alberta Research Council [research reports].* Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages.

In order for chemical reactions, gas adsorption and extractions to take place, reagents and vapors are required to pass into the micropore structure of coal. The objective of this research was to characterize the internal structure of a high-volatile bituminous coal and to follow changes in the pore structure of coal due to extraction by 3 solvents (tetralin, Athabasca bitumen and oil fraction from bitumen) independently, with and without catalytic hydrogenation. The solubilization of coal generates new micropores and degrades the macropore structure. Changes in the pore structure is minor and the pore volume data support the preferential liquefaction of low molecular weight material. None of the optical properties can yet be regarded as sufficiently certain to establish a relationship between main coal macerals and liquefaction data. 12 refs., 1 fig., 2 tabs.

33115 (CONF-8810170–, pp. 186-200) **Recycle oils from fluid coking of coal liquefaction bottoms.** Winschel, R.A. (Consolidation Coal Co., Library, PA (USA)); Burke, F.P. USDOE Pittsburgh Energy Technology Center, PA (USA). 1988. DOE Contract AC22-84PC70018. From DOE direct liquefaction contractor's conference; Pittsburgh, Pennsylvania, USA; 4-6 Oct 1988. In *Direct liquefaction contractors' review meeting. Proceedings.* Order Number DE89009225/JAW. Available from NTIS, PC A22/MF A01; 1.

A series of ten fluid-coker tars, produced by Lummus-Crest, Inc., from coal liquefaction vacuum bottoms, was characterized to evaluate their use as liquefaction recycle oils. The primary variables in the coking tests were temperature (1000 to 1200°F) and coker feedstock source. Most of the properties of the tars are principally influenced by the coking temperature. Those produced at higher temperature are more aromatic, they contain more carbon and less hydrogen, and they are principally unsubstituted and methyl-substituted condensed aromatic compounds. The heteroatom contents of the tars appear to be mainly determined by the coker feedstock; however, heteroatom contents are quite low for these tars. The tars produced at 1000°F are expected to be poor hydrogen donor solvents, whereas those produced at 1200°F can donate virtually no hydrogen. However, a 1200°F tar was readily hydrotreated to produce an excellent donor solvent. None of the tars produced at 100°F or 1100°F were hydrotreated. Since the properties of those tars are different than those produced at 1200°F, they may respond differently to hydrotreating. However, the difference is such that the tars produced at lower temperature are more similar to their feedstock. Therefore, it is expected that their susceptibility to hydrotreating should be intermediate between their feedstock and the high-temperature coker tars. Based on these results, it would appear that tars produced from fluid coking of liquefaction vacuum bottoms can be recycled to a catalytic liquefaction reactor to produce additional liquids without adversely affecting process performance.

33116 (CONF-8810170–, pp. 363-377) **Analysis of biodegraded coals.** Bean, R.M. (Pacific Northwest Lab., Richland, WA (USA)); Campbell, J.A.; Franz, J.A.; Linehan, J. USDOE Pittsburgh Energy Technology Center, PA (USA). 1988. DOE Contract AC06-76RL01830. From DOE direct liquefaction contractor's conference; Pittsburgh, Pennsylvania, USA; 4-6 Oct 1988. In *Direct liquefaction contractors' review meeting.* Order Number DE89009225/JAW. Available from NTIS, PC A22/MF A01; 1.

The ability of certain microbes to degrade low rank coals was first reported by Cohen and Gabrielle. They showed that a white rot fungus, Coriolus versicolor, could metabolize leonardite, an oxidized lignite, producing a high molecular weight, polar, water soluble material. This initial observation has since been extended by a number of laboratories, including Pacific Northwest Laboratory (PNL). It is now clear that a number of microorganisms have the ability to produce enzymes that will act to break down the structure of coal and, in many cases, render it water soluble. There are a number of potentially important commercial applications for this newly recognized process in nature: (1) recovery and utilization of thin seams of coal near the surface, as well as coal surface refuse, which, because of low heating value, have been uneconomical to recover or to burn; (2) a feedstock for further microbial desulfurization, denitrogenation, or demineralization; and (3) a feedstock for anaerobic digestion of coal to produce methane gas. Methods are needed to characterize the chemical nature of the solubilized product and determine the types of reactions taking place during the biosolubilization process. The objective of research at PNL is to develop new methods, and adapt existing methods, for characterizing biodegraded coals. In this paper, they describe the application of gel permeation chromatography (GPC) and ^{13}C nuclear magnetic resonance (^{13}C NMR) to the characterization of oxidized coals, their base solubilized products, and their microbial solubilization products.

33117 (CONF-8810170–, pp. 378-390) **Isotopic methods in coal research.** Finseth, D. (Pittsburgh Energy Technology Center, PA (USA)). USDOE Pittsburgh Energy Technology Center, PA

(USA). 1988. From DOE direct liquefaction contractor's conference; Pittsburgh, Pennsylvania, USA; 4-6 Oct 1988. In *Direct liquefaction contractors' review meeting.* Order Number DE89009225/JAW. Available from NTIS, PC A22/MF A01; 1.

The study of coal structure and coal chemistry requires one to deal with analysis of an enormously complex, heterogeneous system. Such systems often resist attempts to study them by direct instrumental techniques because such techniques are designed to be applicable to pure materials or simple mixtures. Two approaches to this problem can often be helpful. The first approach is to describe the system in terms of an average structure or an overall net chemistry. This statistical view is a very useful way of describing the behavior or structure of a very complex system but it isn't capable of obtaining real molecular level details. A second approach to the study of highly complex systems is to use isotopic labeling to attempt to extract molecular level details. This method is widely used in biology and in medicine to follow the chemistry of trace components in biological systems. In this paper the author discusses several examples of how isotopic labeling, exchange, and dilution have been applied to problems in coal chemistry.

33118 (CONF-8810170–, pp. 457-464) **Physical, chemical and thermodynamic properties of synthetic fuels: past, present and future.** McKinstry, W.E. (Pittsburgh Energy Technology Center, PA (USA)). USDOE Pittsburgh Energy Technology Center, PA (USA). 1988. From DOE direct liquefaction contractor's conference; Pittsburgh, Pennsylvania, USA; 4-6 Oct 1988. In *Direct liquefaction contractors' review meeting.* Order Number DE89009225/JAW. Available from NTIS, PC A22/MF A01; 1.

The purpose of this long term scientific research program is to develop data on fossil fuel synthetic liquids and model compounds which will allow the prediction of physical, chemical, thermophysical and thermochemical properties of any synfuel process stream based on a modest characterization of that stream. Both theoretical and experimental investigations are performed with emphasis on highly precise thermodynamic measurements on defined systems. Properties at temperature and pressure conditions characteristic of synfuel processes are the ultimate goal. Fundamental research on properties correlations is conducted to develop predictive models for process design. Because thermophysical and thermochemical data are determined on complex materials that comprise the liquid products derived from sources such as coal, oil shale, tar sands, heavy petroleum, and heavy ends of petroleum, many experimental techniques need to be utilized. Calorimetric measurements such as combustion calorimetry, adiabatic calorimetry for nonreacting systems, flow calorimetry, etc., are required. Phase behavior studies are also required to provide information on the density, pressure, and compositions of nonreacting systems at various temperatures. Results on transport properties are needed on the same materials subjected to thermophysical studies to provide basic information for extending correlations. Many measurements require the development of improved techniques to reach high temperatures and to give properties on unstable species. Comprehensive characterization studies and thermodynamic measurements are needed to provide a data base which can be used in the search for predictive parameters in light of the known properties of model compounds.

33119 (CONF-8810170–, pp. 504) **Use of high resolution ^{1}H and ^{13}C NMR techniques in the study of fuels and coal derived liquids.** Pugmire, R.J. (Univ. of Utah, Salt Lake City (USA)). USDOE Pittsburgh Energy Technology Center, PA (USA). 1988. From DOE direct liquefaction contractor's conference; Pittsburgh, Pennsylvania, USA; 4-6 Oct 1988. In *Direct liquefaction contractors' review meeting.* Order Number DE89009225/JAW. Available from NTIS, PC A22/MF A01; 1.

Modern high field NMR spectroscopic techniques have been evaluated in order to assess the capabilities of such techniques for the study of jet fuels, coal derived liquids (CDL), and related materials. The utility and quantitative aspects of spectral editing techniques have been evaluated. The DEPT method is one of the more attractive spectral editing pulse sequences but the quantitative aspects of all such editing procedures are quite poor. The proton homonuclear correlation experiment is shown to provide useful information even in complex fuels. The heteronuclear correlation (^{1}H-^{13}C) experiment permits one to sort out overlapping lines in both the proton and carbon frequency domains. The J-coupled 2-D experiment is very useful for characterizing the nature of the carbon resonances as C, CH, CH_2, and CH_3 groups in coal derived liquids and jet fuels. A combination of heteronuclear correlation and J-coupled 2-D experiments allow one to sort and identify the hundreds of resonance lines in fuel samples. The 2-D INADEQUATE method was shown to be a particularly useful experiment for determining carbon-carbon connectivities. A combination of the heteronuclear correlation, J-coupled, and INADEQUATE 2-D experiments prove to be a very powerful combination of techniques for identifying all of the major structural types and fragments in the JP-4, JP-5, and MIG-25 fuels and work is now under way to implement these techniques for the study of CDL's. It is shown that pattern recognition techniques can be used to correlate the data from several different experiments and identify hydrocarbon constituents at a level of detail that exceeds other presently available analytical methods.

33120 (DOE/PC/79925–5) **Chemical characterization of the surface sites of coal: Technical progress report, September 15–December 14, 1988.** Fowkes, F.M.; Riddle, F.L. Jr.; Cole, D.A. Lehigh Univ., Bethlehem, PA (USA). Dept. of Chemistry. Apr 1989. 29p. Sponsored by DOE Fossil Energy. DOE Contract FG22-87PC79925. Order Number DE89013224/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

We propose to do experimental studies in four related areas concerning the acid-base properties of coal surfaces: (1) develop high precision flow microcalorimetric methods for determining the concentrations and strengths of the acidic and basic surface sites of coal powders; (2) develop photo-acoustic FTIR and solid-state NMR spectral shift techniques for determination of the concentrations and strengths of acidic and basic surface sites of coal powders; (3) determine the concentrations and strengths of the acidic and basic surface sites of some of the well-characterized coal samples from Argonne National Labs, comparing the coal samples before and after demineralization treatments with HCl and HF; (4) study the effects of surfaces acidity and basicity on the coal/water interface, with emphasis on the role of interfacial acid-base interactions in the absorption of ions, surfactants and coal/water slurry stabilizers. In our previous report we described a method for determining the heat of acid-base interaction in two-component systems (acid and base) from measured infrared and NMR spectral shifts. Spectral shift measurements in three-component systems are in principal more accurate since through the appropriate choice of neutral solvent, the heat of interaction can be directly obtained. We will present, as an example, the interaction of triethylphosphine oxide with five acids using CCl_4 as the solvent. In addition we show how NMR chemical shifts in three-component systems can be used to characterize the acidity of many of the solvents investigated by Gutmann in two-component, base:solvent systems. 16 refs., 11 figs., 3 tabs.

33121 (DOE/PC/88941–T2) **A study of coal particle shape and three-body wear: Quarterly report, January–March 1989.** Clark, N.N.; Means, K.H. West Virginia Univ., Morgantown, WV (USA). Dept. of Mechanical and Aerospace Engineering. 1989. 25p. Sponsored by DOE Fossil Energy. DOE Contract FG22-88PC88941. Order Number DE89012941/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This project is looking for some relationship between particle shape and three-body wear characteristics. In general, this means to relate a certain wear particle to a certain type of wear track in the specimen. To do this on an individual basis is almost impossible due to the minute size of the particles and the sometimes smaller wear tracks. In looking to establish some type of relationship between shape and wear, one needs to look at what happens to one particle and the surrounding material, and to see what type of track is left behind. We decided to look at basic shapes at first (cubes, spheres, pyramids, etc.), and then try to extend our results to more complex shapes. If successful, we would be able to take the results of the shape analysis group and come up with some type of wear pattern for such a shape. The majority of work this quarter entailed the acquisition and construction of the wear machine and vision system. 3 figs.

33122 (DOE/PETC/TR–89/2) **Analyses of tipple and delivered samples of coal collected during fiscal year 1985.** Schultz,

H.; Retcofsky, H.L.; Davis, L.R. USDOE Pittsburgh Energy Technology Center, PA (USA). [1988]. 36p. Sponsored by DOE Fossil Energy. Order Number DE89004636/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This Department of Energy (DOE) publication updates a series of Topical Reports (formerly "Reports of Investigation") on the quality of coal purchases under specifications for government use. Listed in alphabetical order by state, county, town, and mine are analytical data on the composition and quality of tipple and delivered samples of coal collected during the fiscal year 1985. Tipple samples were collected by certified commercial laboratories in accordance with instructions given by the Analytical Research Branch (ARB), Coal Science Division (CSD). The delivered samples were collected at destination by installation personnel, and all samples were analyzed under the supervision of the DOE-CSD located at the Pittsburgh Energy Technology Center (PETC), Pittsburgh, Pennsylvania, or the US Army General Material and Petroleum Activity Laboratory, located at New Cumberland, Pennsylvania.

33123 (EUR–11843, pp. 131-135) **Apparatus to perform determination of vapor-liquid equilibria between hydrogen and oil from coal hydroliquefaction up to 20 MPa and 673K.** Laugier, S. (Ecole des Mines, Paris (France). Armines, Centre Reacteurs et Processus); Renon, H. Ecole Nationale Superieure des Mines, 75 - Paris (France). Centre Reacteurs et Processus. 1988. (CONF-8806366–: 1. contractors' meeting on the results of the subprogramme 'production and utilization of new energy vectors', Saarbruecken, Germany, F.R., 6-8 Jun 1988). In *Progress in synthetic fuels.*

The proposed study deals with measuring vapor-liquid equilibrium properties between hydrogen and an oil produced by the liquefaction of coal. Recently, a new apparatus for measuring equilibrium between phases, up to 423 K and 10 MPa, was developed at the Centre Reacteurs et Processus of the Ecole Nationale Superieure des Mines de Paris. For hydrogen/oil measurements, the temperature range covered by the apparatus is up to 673 K and pressure range up to 25 MPa. In addition, this new cell has been built with a substance which is not made fragile by hydrogen. The measuring apparatus is based on the static method with phase sampling. An efficient stirring system allows rapidly arrival at equilibrium. The sampling system makes it possible to introduce samples directly into the chromatograph circuit. The samples are taken from inside the cell using capillaries closed by micro-valves. The analysis is carried out by gas phase chromatography. The amounts of hydrogen present are measured by a catharometer and the oil with flame ionization detector. The preliminary test results will be presented. 1 ref., 3 figs., 1 tab.

33124 (SVF–325) **Nitrogen components in coal peat and petroleum. Literature study.** Bengtsson, M. Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden). Nov 1988. 95p. (In Swedish). Order Number DE89776249/JAW. Available from NTIS (US Sales Only), PC A05/MF A01;1.

Nitrogen compounds in living organic tissues mainly appear in proteins. Protein derived amino acids can still be identified in peat. Besides also amino acids from bacteriological activities (fixation of nitrogen from the air) are found. Nitrogen content of peat and coal are 10-20 times higher then in the original tissues. Nitrogen content in Swedish peat resources of economical importance is 1.7 - 2.4% N. During the peat stage a transformation of amino acids into more complex cyclic compounds as pyridine, indol and purines proceeds parallel to the increase in molecule sizes and complexity. Several of these nitrogen compound can be recognized both in petroleum and coals. Amino acid no longer can be identified in lignite. The molecules increase their aromaticity and the number of aromatic rings in each cluster. During the subbituminous and bituminous stage the nitrogen content increases to reach a maximum (of approx. = 1.4 - 2.8% N) at approx. = 83% C. The dominating nitrogen compund types in coal are pyrrolic and pyridinic, occurring in the ratio of 2:1. These compounds are found in clusters usually containing at least 3-4 aromatic rings. These clusters remain intact in coal tars. They are enriched in the most heavy tar fractions. In petroleum the amount of pyrrolic nitrogen is only approx. = 15% of the total nitrogen. Naftaltenes and resins appearing as heavy colloidal substances cointain most of the nitrogen in crude oil. Besides porphyrin compounds contain nitrogen bound to vanadine or nickel. Nitrogen compounds enrich in heavy fuel oils while the light destillates are almost nitrogen free. Combustion trials of model nitrogen compounds have given a higher conversion of pyrrolic nitrogen to NO_x than of basic nitrogen compounds. (With 68 refs.)

33125 **Coal fueled diesel developments.** Flynn, P.L.; Hsu, B.D. 10p. Society of Automotive Engineers, Warrendale, PA (1988). (CONF-880897–: Conference and exposition on future transportation technology, San Francisco, California, USA, 8-11 Aug 1988).

Technical Paper 881151.

Coal-fueled diesel engines hold the promise of operating on a cheap, domestically abundant fuel in a wide range of applications. The technical challenges appear to be solvable by existing or near-term developments. The successful application of a coal-fueled diesel engine will require the simultaneous development of a fuel source, engine combustion, wear and emission control systems, and the support infrastructure in the operating environment. Recent studies show that a coal water mixture fueled diesel locomotive can be economically attractive at reasonable oil price levels.

0108 Waste Management

Refer also to citation(s) 33090, 33091, 33108, 33113, 33146, 33150, 33437, 33438, 33439, 33440, 33441, 33442, 33443, 33444, 33446, 34054

33126 (CRIEPI-T–87076) **A solidification method of low level radioactive waste using fly ash.** Kambe, H. (and others). Central Research Inst. of Electric Power Industry, Tokyo (Japan). 1988. vp. (In Japanese). Available from Central Research Inst. of Electric Power Industry, Tokyo (Japan).

Basic investigation was conducted so as to make the liquid waste produced in the PWR and BWR power stations (boric acid and sodium sulfate respectively) into nonflammable solid waste with high volume loss, sufficient strength, and low leachability suitable for land disposal, by making use of fly ash produced from thermal power coal. (1)PWR's solidified waste containing 2.5 boric acid per 1.0 fly ash (rate by weight) can be produced at 1100 degrees C. The volume of waste can be reduced to less than one third in comparison with the conventional method. The strength of the solidified waste is over 1 ton cm^2, and its leachability is low enough; (2) BWR's solidified waste containing 0.8 sodium sulfate per 1.0 fly ash (rate by weight) can be produced at 850 degrees C. The volume of waste can be reduced to one fifth in comparison with the conventional method. The strength of the solidified waste is approx. 300 kg/cm^2, and its leachability seems to be equivalent to that of solidified cement. However, the leachability of sodium is high, so it is necessary to take countermeasures such as coating.

33127 (DOE/MC/24160–2671) **Reaction kinetics and simulation models for novel high-temperature desulfurization sorbents: Final report.** Woods, M.C.; Leese, K.E.; Gangwall, S.K.; Harrison, D.P.; Jothimurugesan, K. Research Triangle Inst., Research Triangle Park, NC (USA); Louisiana State Univ., Baton Rouge, LA (USA). Feb 1989. 141p. Sponsored by DOE Fossil Energy. DOE Contract AC21-87MC24160. Order Number DE89000950/JAW. Available from NTIS, PC A07/MF A01 - OSTI; GPO Dep.

A kinetic study of two mixed-metal oxide sorbents (zinc ferrite and zinc titanate) was conducted to obtain kinetic data at the temperatures and pressures typically encountered in coal gasifiers. These sorbents are used to remove H_2S from the hot coal- derived gases and can be subsequently regenerated for use in a cyclical operation. The qualitative behavior of zinc titanate was found to be quite similar. Sulfidation kinetic rate increased with H_2S concentration, slightly increased with temperature, increased with pressure at a constant H_2S mol fraction with pressure at a constant H_2S partial pressure, and increased with decreasing pellet diameter. The regeneration rates of both zinc ferrite and zinc titanate increased with temperature, O_2 concentration, and pressure at a constant O_2 mole fraction. The formation of zinc sulfate was found to be significant during regeneration of zinc ferrite at sufficiently low temperatures, high pressures, and high O_2 concentrations. Reducing gas concentrations of 65-75% (H_2 + CO) simulating the output from the Texaco

gasifier operated in the oxygen-blown mode were used to assess the impact on sorbent performance. The shrinking core kinetic model was found to fit the experimental data very well. Correlations were made using a priori estimates of all parameters including diffusivity and mass transfer coefficients. Quantitative agreement was best obtained by treating the diffusivity term and/or the mass transfer term as best fit parameters. 22 refs., 69 figs., 18 tabs.

33128 (EPRI-GS–6431) **Ash utilization in highways: Pennsylvania demonstration project.** Glogowski, P.E. Electric Power Research Inst., Palo Alto, CA (USA); GAI Consultants, Inc., Monroeville, PA (USA); Duquesne Light Co., Pittsburgh, PA (USA). c Jun 1989. 132p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Coal combustion by-product production in the United States provides a significant volume of material available for the construction industry. Fly ash production alone provides over 50 million tons of material per year. Of this amount, only 20 percent is used beneficially, with the remaining material placed in economically burdensome disposal areas. Utilities and society as a whole are therefore motivated to consider coal ash in a resourceful manner. To this end, EPRI, through the promotion of coal ash use research and demonstration projects, and the Pennsylvania legislature, through the passage of the Coal Ash Beneficial Use Act, Pennsylvania Act No. 168 of 1986, are promoting the large volume use of coal ash. The I-279, East Street Valley experimental project, completed in 1988, demonstrates the feasibility of using a coal combustion by-product, predominantly Class F fly ash in large volume structural embankment fills for highway construction. This report describes in detail the testing, analysis and design, construction, and embankment performance monitoring conducted in support of this ash use demonstration project. 32 figs., 11 tabs.

33129 (VTT-SYMP–83, pp. 251-262) **Particle measurements at the Otaniemi PFBC/G test rig.** Hulkkonen, S. (Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Energy Economics and Power Plants). Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). 1988. (CONF-8711302–: Seminar on pressurized fluidized bed combustion and gasification power systems, Espoo, Finland, 23-24 Nov 1987). In *Pressurized fluidized bed combustion and gasification systems.* Order Number DE89766970/JAW. Available from NTIS (US Sales Only), PC A13/MF A01.

One of the most difficult problems in the commercialization of PFBC technology is hot gas cleanup. Hot and compressed gass have to be cleaned effectively enough before the gas turbine to ensure a reasonable gas turbine life time. At the PFBC/G test rig combustion gases are cleaned in a two-stage cyclone collector. The efficiency of the first cyclone is quite low and it is considered as a pre-collector. The secondary cyclone is similar but not identical to the standard high efficiency Stairmand design. The diameter of the secondary cyclone is 103 mm. Particle measurements are based on isokinetic sampling. Isokinetic sample flow is extracted before and after the two cyclones. The particle concentration is measured using a total filter which is electrically heated to maintain the temperature at 200 deg C. The system operates at plant pressure. The isokenetic sample flow is expanded through a critical nozzle and diluted using heated clean air before impacto measurement. The performance of the cyclones is determined from the exit dust sample and the samples taken from the captured dusts. The first measurements were made at pressures in the 5 to 10 bar range at different excess air levels using crushed peat pellets as fuel. The elutriation from the reactor was 2000-4000 mg/m3n and the cyclone system reduced the concentration of particles to 70-150 mg/m3n at the secondary cyclone outlet. The overall collection efficiency of the secondary cyclone was about 90%. The mass mean diameter of the elutriated particles was about 30 μm and at the outlet the mass mean diameter was 2-4 μm. Size distribution analysis by Coulter Counter agreed quite well with impactor measurements.

33130 (VTT-SYMP–83, pp. 237-250) **Didier hot gas filter systems.** Weidner, U. (Didier filtertechnik, Pflaz (Germany, F.R.)). Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). 1988. (CONF-8711302–: Seminar on pressurized fluidized bed combustion and gasification power systems, Espoo, Finland, 23-24 Nov 1987). In *Pressurized fluidized bed combustion and gasification systems.* Order Number DE89766970/JAW. Available from NTIS (US Sales Only), PC A13/MF A01.

Didier, founded in 1834, is one of the biggest and most renown companies in refactory field, solving high-temperature problems up to 2000 deg C. Didier filtertechnik (DF) founded by Wilhlm Schuler in 1887 and acquired by Didier in 1957, is a leading manufacturer of filter material (porous ceramics), gas and liquid filters as well as of fine-bubble diffusers for sewage aeration. For 20 years DF has been planning and constructing high-efficient hot gas filter system fot the direct, dry cleaning of hot gases at temperature ranges up to 1000 deg C. According to this process, in which the filter is located immediately after the firing systems, that is heat exchangers are installed behind the separators, corrosion problems are thus prevented as no cases arise in which the tempefalls below the dewpoint. Optimum heat recovery is also provided. In the flue gas dust precipitation and product recovery the limiting temperature of application for ceramic candle filters - depending on the material of filter media - was for a long time approximately 400 deg C to 600 deg C. In 1970/71 DF developed for the first time refactory-lined filters on a commersial scale for continuous temperatures 800 deg C to 900 deg C. In 1981/82 a complete pilot plant was constructed by DF for Japanese licence, for working temperatures of 1000 deg C. The filters mentioned so far operate at atmospheric conditions. On the basis of developments in the Didier Group with regard to special high-tech tube-sheets, refactory-lined and high-temperature insulated pressure vessels, complete high-temperature high-pressure (HTHP) filters are designed since 1980. They are achieving excellent clean gas values (e.g. residual dust content in clean gas <1 mg/nm3) and thus satisfy the conditions required in pressurised fluidised bed combustion and gasification - based (PFBC/G) combined cycle applications before the gas turbines.

33131 **Adsorption and photodegradation of pyrene on magnetic, carbonaceous, and mineral subfractions of coal stack ash.** Dunstan, T.D.J. (Univ. of Tennessee, Knoxville (USA)); Mauldin, R.F.; Jinxian, Z.; Hipps, A.D.; Wehry, E.L.; Mamantov, G. *Environmental Science and Technology (USA),* 23(3): 303-308 (Mar 1989). DOE Contract AS05-81ER60006;FG05-87ER60552.

Two coal stack ashes have been separated into three principal subfractions (carbonaceous, mineral, and magnetic). Photoreactivities and adsorptivities of pyrene on the three subfractions have been determined, the latter by gas-solid chromatography. For each ash, the carbonaceous subfraction is the strongest adsorbent and has the greatest ability to stabilize adsorbed pyrene toward photodegradation, while the mineral subfraction is a much weaker adsorbent and pyrene adsorbed on it shows relatively high photoreactivity. The magnetic subfraction is the weakest adsorbent, but any pyrene adsorbed on its surface is relatively resistant to photodegradation. The presence of even a small quantity of carbon in coal ash leads to stabilization of adsorbed pyrene toward photodegradation, by comparison with silica, alumina, or glass surfaces. The relative quantity of carbon in coal ash appears to be the main factor determining the extent of photochemical reactivity of pyrene adsorbed on the surface. In coal ashes that contain a relatively large quantity of iron, the magnetic particles may play a minor role in stabilizing adsorbed pyrene toward photodegradation.

0109 Environmental Aspects

Refer also to citation(s) 33125

0110 Reserves and Exploration

Refer also to citation(s) 33648

33132 (DGMK–384-1) **Facies and genesis of upper carboniferous coal seams from Northwest Germany. Final report. Pt. 1.** Strehlau, K. Deutsche Wissenschaftliche Gesellschaft fuer Erdoel, Erdgas und Kohle e.V., Hamburg (Germany, F.R.); Bochum Univ. (Germany, F.R.). Inst. fuer Geologie; Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). Nov 1988. 380p. (In German). Available from Copy held by UB/TIB Hannover.

Whole coal seams of the Upper Carboniferous (Westphalian C, D) of Northwest Germany were investigated with coal petrological

methods. Based on these investigations four main facies and thirteen subfacies could be distinguished. They represent environments in the former moors. Moreover different types of seams could be defined. The detailed evaluation of published studies concerning older coal seams of the Ruhr Carboniferous (Westphalian A-C) showed shat in this region beginning with the middle Westphalian C the former moors covered smaller areas than before. Clastic influences and mild oxidation affected the moors more often. At the same time (Westphalian C, D) in the Carboniferous of Ibbenbueren the clastic and oxidative influences upon the moors were more marked than in the Carboniferous of the Ruhr Basin. (orig.) With 172 figs., 39 tabs., 15 pictures.

0120 Mining

Refer also to citation(s) 33151, 33207, 33366, 34755

33133 (DOE/EIA–0064(87)) **Coal data: A reference.** USDOE Energy Information Administration, Washington, DC (USA). Office of Coal, Nuclear, Electric and Alternate Fuels. 17 May 1989. 94p. Sponsored by DOE Management & Administration. Order Number DE89013218/JAW. Available from NTIS, PC A06/MF A01 - GPO - OSTI; GPO Dep.

This report provides basic information on the mining and use of coal, an important source of energy in the United States. The report is written for a general audience. The goal is to cover basic material and strike a reasonable compromise between overly generalized statements and detailed analyses. The section "Coal Terminology and Related Information" provides additional information about terms mentioned in the text and introduces new terms. Numerous graphs, maps, photographs, and other illustrations have been included to show trends, patterns, geographic locations, and to give examples of equipment, mining operations, and similar coal-related activities. 146 refs., 32 figs., 37 tabs.

33134 (NME–1986, pp. 103-107) **Fuel peat harvesting project report. St. Shotts Peat Project St. Shotts, Newfoundland.** Hewitt, P. (Avalon Peat Harvesting, St. Shotts, NF, Canada). Mercy Hospital and Medical Center, Chicago, IL (USA). 1986. (CONF-8611290–: Wood and peat energy conference, Gander, Canada, 17-19 Nov 1986;MICROLOG–89-01972). In *The power of alternative. Energy from wood and peat.* Available from Dept. of Mines and Energy, PO Box 4750, St. John's, NF, Canada A1C 5T7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The blanket bogs near Saint Shotts on the Southern Avalon peninsula of Newfoundland contain some of the highest quality peats known today. In 1982, the Southern Avalon Development Association began developing these bogs as a sod fuel peat demonstration project. Bog ditching and surfacing ae described. For peat cutting, an Irish extruder known as the Herbst Super Cutter is used. The peat is dried to a 40-50% moisture content and then collected and stockpiled. Anther method employed in producing sod fuel peat is family potting, whereby the company extrudes the peat and sells it as is, where is. Land reclamation is discussed after the example of Ireland; it can be achieved by planting vegetables (onions) or sewing grass for cattle breeding. 1 fig.

0130 Transport and Handling

33135 (DOE/PC/90959–T9) **Microscopic modelling of sound waves in granular material: Quarterly progress report, January 1, 1989–March 31, 1989.** Haff, P.K. Duke Univ., Durham, NC (USA). Dept. of Civil and Environmental Engineering. Mar 1989. 16p. Sponsored by DOE Fossil Energy. DOE Contract FG22-86PC90959. Order Number DE89012399/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Our work over the past several years has been directed toward a detailed examination of the transmission of sound through dry granular materials at the microscopic level. Such a granular system consists of a contact network along which, and only along which, the momentum impulses which comprise the sound wave may travel. In the past several years we have studied two such systems. In one of these grains cascaded down an incline, and the pressure impulses recorded on the bed were studied using computer simulation. We looked at both thin and thick flows. The second type of system studied was a collection of quasi-static grains subjected to compressive loading. 8 refs., 5 figs.

33136 (PB–89-139653/XAB) **Report on the transportation of coal: baseline energy forecast, rail investment forecast, evaluation of capital requirements and availability, impacts on the Appalachian region.** Booz, Allen and Hamilton, Inc., Bethesda, MD (USA). Dec 1981. 150p. Available from NTIS, PC A07/MF A01.

This report, completed in 1981 includes a baseline energy forecast, a rail-investment forecast, and an evaluation of the capital requirements and availability for Appalachian rail carriers. The energy forecast focuses on the regional markets for Appalachian coal and an assessment of key factors influencing energy markets over the next ten years. The rail-investment forecast requirements and projects rail investment in Appalachia. The evaluation of capital requirements and availability for Appalachian rail carriers analyzes capital needs for major carriers and projects capital expenditures, equipment utilization, and predicts some levels of rate increases. Coal-related investments are separated from noncoal investments. Rail abandonment and its impact on service in the Region is addressed.

0140 Combustion

Refer also to citation(s) 33108, 33109, 33129, 33430, 33652, 33815

33137 (CONF-890402–7) **State-of-the-art computation of dynamics and erosion in fluidized bed tube banks.** Lyczkowski, R.W.; Folga, S.; Chang, S.L.; Bouillard, J.X.; Wang, C.S.; Berry, G.F.; Gidaspow, D. Argonne National Lab., IL (USA). Oct 1988. 39p. Sponsored by DOE Fossil Energy. DOE Contract W-31109-ENG-38. From 10. international conference on fluidized-bed combustion; San Francisco, California, USA; 30 Apr - 3 may 1989. Order Number DE89014669/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Argonne National Laboratory's state-of-the-art hydrodynamic and erosion modeling capabilities are summarized in this paper. Recent improvements in the hydrodynamic model, and the monolayer energy dissipation and Finnie erosion models are explained as are the implementation of the Neilson-Gilchrist erosion model. Hydrodynamic results are presented and the erosion models are compared with each other for a generic two-dimensional few-tube approximation of a cold model fluidized bed combustor experiment as well as for single round and square tubes. Power spectral methods constituting means, autocorrelations, power spectral densities, variances ad cross-correlations are used to analyze the hydrodynamic results and to attempt correlating them with the erosion patterns and rates. All of the erosion models predict order of magnitude agreement with each other and with limited erosion data. However, the monolayer energy dissipation model produces more reliable trends such as the effect of fluidizing velocity on the overall erosion rate. 29 refs., 13 figs., 2 tabs.

33138 (CRIEPI-W–87030) **Study on low calorific gas combustion (Part 4).** Nakata, T. (and others). Central Research Inst. of Electric Power Industry, Tokyo (Japan). 1988. vp. (In Japanese). Available from Central Research Inst. of Electric Power Industry, Tokyo (Japan).

This report describes the fundamental characteristics of premixed combustion and its application to gas turbine combustor. It has been definitely shown by the study that premixed combustion method should be effective for low NOx emission as well as stable combustion when combined with two stage combustion.

33139 (DOE/ER/01198–T14, pp. 131-142) **Microchemistry of solids.** Wert, C.A. Illinois Univ., Urbana, IL (USA). Materials Research Lab. Mar 1988. In *Materials Research Laboratory: Renewal proposal for the extension in time and funds.* Order Number DE88013776/JAW. Available from NTIS, PC A99/MF A01; 1.

Oxidation of sulfur during combustion of coal is a troublesome technological and economic problem. Both the sulfur bound up in mineral pyrite and sulfate and the sulfur distributed atom-by-atom through the hydrocarbon matter (the organic sulfur) pose significant problems. Even understanding the details of the oxidation is difficult,

since so many changes take place together in coal in the temperature range of interest (400°C upward): pyrite and sulfate are converted to one of several oxides, the hydrocarbon matrix swells, softens and finally melts, organic sulfur is oxidized, and clays and other minerals are altered and finally melt. The authors are examining one aspect of these problems, the oxidation of pyrite and organic sulfur. The analytical method uses the best TEM techniques. They are applying the same techniques to characterize CuInSe, a semiconductor compound widely believed to have promise as a high-efficiency, Se_2 large-area solar cell material.

33140 (ECN–89-065) **Attrition of chars in fluidised bed combustion.** Vleeskens, J.M.; Roos, C.M. Netherlands Energy Research Foundation, Petten (Netherlands). May 1989. 18p. Available from Netherlands Energy Research Foundation ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

The propensity of chars to attrition in fluidised bed combustion was studied using petrographic methods. It was observed that the mode of attrition varies with rank, whereas the quantitative effect of attrition on combustion efficiency is independent of rank. In chars formed from medium- and low-volatile coals, isotropic matter is more prone to attrition than anisotropic coke. Anisotropic chars derived from high-volatile coals undergo attrition to the same degree as the accompanying isotropic char. The quantitative effect of char attrition on burnout was investigated in combustion experiments using bed materials of different hardness. Using fresh sand instead of used, ash-containing bed material reduced fuel loss to the same extent as obtained by a five-fold increase of residence time. The reduction of fuel loss observed was the same for medium and high-volatile coals. 5 figs., 6 refs., 2 tabs.

33141 (EPRI-GS–6402-Vol.1) **Characterizing fuels for utility-scale atmospheric fluidized-bed combustors: Volume 1, Initial development.** Chandran, R.R.; Duqum, J.N.; Jafari, H.C.; Rowley, D.R.; Perna, M.A. Electric Power Research Inst., Palo Alto, CA (USA); Babcock and Wilcox Co., Alliance, OH (USA). Research and Development Div. c Jun 1989. 166p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The Electric Power Research Institute is sponsoring development of a new method of characterizing fuels for bubbling atmospheric fluidized-bed combustion (AFBC) boilers. Compared to today's alternative of testing at a large-scale AFBC unit, the fuels characterization method will allow low-cost characterization for utilities considering AFBC applications or a change of fuel in an existing unit. The method utilizes bench-scale test equipment for characterization and a mathematical model, or performance code, to predict combustion performance at large scale using the bench-scale test results. To validate the bench-scale tests and the performance code, the code predictions are compared with actual large-scale AFBC units. This interim report documents the early stages of the fuel characterization method development at Babcock and Wilcox, during 1985 and 1986. During this period, pertinent fuel characteristics were identified, tests to obtain data on those characteristics were developed, and test facilities built and tested. The in-bed combustion portion of the performance code was developed. When preliminary data from the test rigs were input into the code, the code predicted in-bed combustion efficiency that agreed well with actual results from small- to pilot-scale AFBC units. A final report documenting the entire project will be prepared at the close of the project, scheduled for mid-1990. 75 refs.

33142 (EPRI-GS–6402-Vol.2) **Characterizing fuels for utility-scale atmospheric fluidized-bed combustors: Volume 2, Appendixes.** Chandran, R.R.; Duqum, J.N.; Jafari, H.C.; Rowley, D.R.; Perna, M.A. Electric Power Research Inst., Palo Alto, CA (USA); Babcock and Wilcox Co., Alliance, OH (USA). Research Center. c Jun 1989. 148p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The Electric Power Research Institute is sponsoring development of a new method of characterizing fuels for bubbling atmospheric fluidized-bed combustion (AFBC) boilers. Compared to today's alternative of testing at a large-scale AFBC unit, the fuels characterization method will allow low-cost characterization for utilities considering AFBC applications or a change of fuel in an existing unit. The method utilizes bench-scale test equipment for characterization and a mathematical model, or performance code, to predict combustion performance at large scale using the bench-scale test results. To validate the bench-scale tests and the performance code, the code predictions are compared with actual large-scale AFBC units. This interim report documents the early stages of the fuels characterization method development at Babcock & Wilcox, during 1985 and 1986. During this period, pertinent fuel characteristics were identified, tests to obtain data on those characteristics were developed, and test facilities built and tested. The in-bed combustion portion of the performance was developed. When preliminary data from the test rigs were input into the code, the code predicted in-bed combustion efficiency that agreed well with actual results from a small- to pilot-scale AFBC units. A final report documenting the entire project will be prepared at the close of the project, scheduled for mid-1990.

33143 (LUTMDN-TMVK–5172-1-90-1988) **Empiric model of pulverized coal combustion.** Jedeur-Palmgren, M.; Rosen, P. Lund Univ. (Sweden). Dept. of Heat and Power Engineering; Studsvik Energy, Nykoeping (Sweden). Nov 1988. 91p. (In Swedish). (STUDSVIK-EP–88-30). Order Number DE89776241/JAW. Available from NTIS (US Sales Only), PC A05/MF A01;1.

Combustion of single coal particles are described in a mathematical model using both empiric and theoretical formulas. Burn-out of the particle is then described in a computer code using data from the coal analysis for input. (O.S).

33144 (STEV-FBT–89-10) **Bulk density and heat transfer in cirulating fluidized bed boilers.** Johnsson, F. Statens Energiverk, Stockholm (Sweden). 1987. 91p. Order Number DE89776261/JAW. Available from NTIS (US Sales Only), PC A05/MF A01;1.

In this study available theories and mathematical models are applied to results from measurements in full-scale boilers. A CFBB is defined as a boiler with a non-stationary bed, that is the bed material recirculates to an extent controlled by operating parameters such as the fluidizing velocity, the rate of aeration of an L-valve and the amount of bed material in the boiler. The thesis consists of the following parts: - A report on bulk density and heat transfer in CFBB's, this part. - Heat Transfer in FBB - discussion on models. Paper presented at the IEA meeting on mathematical modeling, Boston, May 1987. - Heat flow measurements in fluidized bed boilers. Paper presented at the 9th International Conference on Fluidized Bed Combustion, Boston, May 1987. A probe for Heat Flow Measurements in Fluidized Bed Boilers. Paper presented at the 14th IEA AFBC Technical Meeting, Boston, May 1987. The first part of the thesis concerns a bulk density and heat transfer study carried out on a CFBB. Flow regimes are discussed, and measurements of the bulk density and heat transfer distribution in a CFBB are presented together with results obtained with a mathematical model for calculating the heat transferred to the walls of the combustion chamber. The heat transfer model is presented in the second part. This paper also includes a comparison of the vertical bulk density distribution in a CFBB and an SFBB and a comparison with results obtained from a cold model. The third part consists of a comparison between the heat transfer in an SFBB and that in a CFBB. An investigation of the heat flow meters used is presented in the fourth part. (40 refs.).

33145 (SVF–324) **Secondary fuel feed to a pulverized coal flame to reduce NO_x emission.** Rudling, L. Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden). Nov 1988. 81p. (In Swedish). Order Number DE89776248/JAW. Available from NTIS (US Sales Only), PC A05/MF A01;1.

The efficiency of different reburning fuels during combustion of pulverized coal has been investigated. The NO_x reduction as a function of residence time and temperature in the reburning zone was also investigated. The experiments were carried out in an experimental furnace with the dimensions diameter 0.3 meter and length 4.0 meter. As primary fuel pulverized coal (10 kg/h) with a nitrogen content of 1.4% N (dry weight basis) was used. As reburning fuel the following fuels were investigated - propane - light fuel oil (0.2% N) - pulverized wood (0.3% N d.w.b.) - pulverized coal (1.3% N d.w.b.). Reburning with propane gave the lowest NO_x-emission, 75 mg NO_x/MJ. The other investigated reburning fuels gave a NO_x-emission of 100 mg NO_x/MJ. Decreasing the residence time in the

reburning zone from 1 second to 0.5 seconds increased the NO_x-emission 25-50%. An increased temperature in the reburning zone, from 1100-1200 degrees to 1300-1400 degrees, gave consistently a decreased NO_x-emission. The temperature in the post combustion zone did not influence the NO_x-emission to any measurable extent. Reburning with pulverized coal gave a lower degree of burnout of the fly ash, compared to reburning with pulverized wood.

33146 (VTT-SYMP–83) **Pressurized fluidized bed combustion and gasification systems.** Korhonen, M. Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). 1988. 288p. (CONF-8711302–: Seminar on pressurized fluidized bed combustion and gasification power systems, Espoo, Finland, 23-24 Nov 1987). Order Number DE89766970/JAW. Available from NTIS (US Sales Only), PC A13/MF A01;1.

The Seminar on Pressurized Fluidized Bed Combustion and Gasification Power Systems was held in Espoo, Finland, on 23-24 November, 1987. The topics of the Seminar were related to a joint research project between he Technical Research Centre of Finland (VTT), the Helsinki Univrsity of Technology, and Imatran Voima Oy. The objective was to take a general review of the state-of-the-art of combined cycle power plant processes based on pressurized combustion and gasification. Foreign specialists had been invited to lecture at the Seminar. Research done in Finland was also introduced. The lectures given on the first day focused on potentials offered by pressurized combustion technology in Finland, and on research and development in the field of pressurized fluidized bed combustion. A visit was also organized to see the test rig constructed for research into pressurized fluidized bed combustion and gasification at the Laboratory of Fuel Processing of VTT. The lectures on the second day concerned gasification technology and gas cleanup from particulates and alkali metals.

33147 (VTT-SYMP–83, pp. 53-57) **Otaniemi PFBC/G testing and research project.** Hulkkonen, S. (Helsinki Univ. of Technology, Otaniemi (Finland). Inst. of Energy Engineering); Jahkola, A.; Kurkela, E. Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). 1988. (CONF-8711302–: Seminar on pressurized fluidized bed combustion and gasification power systems, Espoo, Finland, 23-24 Nov 1987). In *Pressurized fluidized bed combustion and gasification systems.* Order Number DE89766970/JAW. Available from NTIS (US Sales Only), PC A13/MF A01.

The research project Experimental Research of Pressurized Fluidized Bed Technology and its Application to Combined and Heat Generationwas started in 1986. The project is carried out in co-operation between Helsinki University of Technology (TKK), Technical Research Centre of Finland (VTT) and Imatran Voima (IVO). The project is scheduled for year 1986-1989 and is mainly financed by the Ministry of Trade and Industry (KTM). The total costs of the project are 10 million FIM including the test facilities. The objective of the project is to create knowledge of the basics of pressurized fluidized bed combustion/gasification and their applications. The fuel of main interest is peat. The research is realized partly theoretically based on literature studies and computer runs but primarily by experimental measurements carried out using the PFBC/G test rig.

33148 (VTT-SYMP–83, pp. 59-98) **PFBC research and development - British experiences.** Hoy, R.H. (Hoy Associates Ltd., Leatherhead (UK)). Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). 1988. (CONF-8711302–: Seminar on pressurized fluidized bed combustion and gasification power systems, Espoo, Finland, 23-24 Nov 1987). In *Pressurized fludized bed combustion and gasification systems.* Order Number DE89766970/JAW. Available from NTIS (US Sales Only), PC A13/MF A01.

The UK involvement in the development of PFBC is outlined with particular reference to the period up to the end of 1984.

33149 (VTT-SYMP–83, pp. 121-131) **Pressurized fluidized bed combustion of peat.** Horvath, A. (Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Energy Economics and Power Plants). Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). 1988. (CONF-8711302–: Seminar on pressurized fluidized bed combustion and gasification power systems, Espoo, Finland, 23-24 Nov 1987). In *Pressurized fluidized bed combustion and gasification systems.* Order Number DE89766970/JAW. Available from NTIS (US Sales Only), PC A13/MF A01.

Combustion and emission properties of peat (a fuel of high volatile and low ash content) were investigated under the special conditions of pressurized fluidized bed combustion. At the Otaniemi PFBC/G test rig, during a total of 150 hours of test runs crushed peat pellets of about 20% moisture were burnt. Natural silica sand was used as the bed material. The bed height was 0.6-1.2 m depending on operating pressure and thermal input. The pressure levels of operation were 5.7 and 10 bar (abs.). The amount of excess air was varied between 10 and 50%. The flue gas composition was monitored continuously after the two stage cyclone collector, using pressure reduction and double sampling system. Gas samples were also taken from the bed, freeboard and downstream of the cyclones. Bed material and flyash samples were analysed in respect of fuel burn out. Combustion efficiency was over 99%. The losses caused by unburnt carbon in fly-ash were very low. Carbon monoxide emission was always below 90 mg/MJ, effected by the bed temperature. The emitted amount of sulphur dioxide was smaller than 160 mg/MJ (peat has a low sulphur content of 0.2%wt, d.b.). Sulphur trioxide was found in the flue gases and due to that rigorous low temperature corrosion appeared. NO_x-emission was in the range of 10 to 100 mg/MJ strongly influenced by excess air. The effect of pressure on NO-formation appeared to be moderate. Compared to atmospheric fluidized bed burning of peat, slightly better combustion and emission performance were experienced in the pressurized fluidized bed combustor.

33150 (VTT-SYMP–83, pp. 263-285) **Thermodynamic study of alkali metals release in pressurised fluidised-bed combustion and gasification of peat.** Mojtahedi, W. (Secretaria de Asentamientos Humanos y Obras Publicas, Mexico City (Mexico)); Backman, R. Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). 1988. (CONF-8711302–: Seminar on pressurized fluidized bed combustion and gasification power systems, Espoo, Finland, 23-24 Nov 1987). In *Pressurized fluidized bed combustion and gasification systems.* Order Number DE89766970/JAW. Available from NTIS (US Sales Only), PC A13/MF A01.

A combined-cycle power generation system incorporating pressurised fluidised-bed combustion (PFBC) or gasification is considered a promising approach for electricity generation using solid fuels such as peat. In these systems, the high-pressure hot flue gas is expanded in a gas turbine. Peat contains sodium and potassium which are released in combustion and gasification. These are corrosive elements that can cause severe damage to the turbine blades if not suppressed. Multicomponent, multiphase equilibrium calculations were carried out for atmospheric and pressurised fluidised-bed operating conditions to determine the relative distribution of the two metals (Na and K) in the gas and condensed phases. Dependence of the alkali volatilisation on the operating temperature, pressure, the chlorine-content and the total alkali-content of the feedstock was studied. The results show that the alkali release in the vapour-phase could be much higher than acceptable to a gas turbine, particularly under gasification conditions. Hence the necessity to remove the volatilised alkali-metal compounds is more acute in gasification than in combustion. Both sodium and potassium are present as chlorides and to a lesser extent as hydroxides in the gas phase in both modes of operation (i.e. combustion and gasification). However, whereas under combustion conditions both metals seem to condense as sulphates (Na_2SO4 and K_2SO4), in gasification, chlorides and carbonates dominate in the condensed phase. The alkali-metals volatilisation shows strong dependence on the operating pressure of the system as well as on the chlorine-content of the feedstock. It decreases markedly with the former but increases sharply with the latter.

0150 Marketing and Economics

Refer also to citation(s) 33133

33151 (DOE/EIA–0121(88/4Q)) **Quarterly coal report, October–December 1988.** USDOE Energy Information Administration, Washington, DC (USA). Office of Coal, Nuclear, Electric and Alternate Fuels. 5 May 1989. 141p. Sponsored by DOE Fossil Energy. Order Number DE89011793/JAW. Available from NTIS, PC A07/MF A01 - GPO - OSTI; GPO Dep.

The Quarterly Coal Report provides comprehensive information about US coal production, exports, imports, receipts, consumption, and stocks to a wide audience, including Congress, federal and state agencies, the coal industry, and the general public. The data presented in this report are collected and published by the Energy Information Administration (EIA) to fulfill data collection and dissemination responsibilities as specified in the Federal Energy Administration Act of 1974 (P.L. 93-275) as amended. This issue presents detailed quarterly data for October through December 1988, year to date data, aggregated quarterly historical and projected data for 1980 through 1990, and aggregated annual historical and projected data for 1960 through 2000. Appendix C displays, from 1980 on, detailed quarterly historical coal imports data, as specified in Section 202 of the Energy Policy and Conservation Amendments Act of 1985 (P.L. 99-58). Appendix D gives selected quarterly tables converted to metric tons. 7 figs., 37 tabs.

33152 (DOE/EIA–0333(89)) **Annual outlook for US coal 1989 with projections to 2000.** USDOE Energy Information Administration, Washington, DC (USA). Office of Coal, Nuclear, Electric and Alternate Fuels. 1 Jun 1989. 51p. Sponsored by DOE Management & Administration. Order Number DE89013099/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

As an integral part of the overall energy projections presented by the Energy Information Administration (EIA) in the recently published Annual Energy Outlook 1989, this report presents the detailed forecast for US coal supply and demand through the year 2000. It focuses on the base case projections, but also presents the projections for alternative cases including one that assumes lower transportation costs and faster productivity gains, as well as higher economic growth. The major legislative and regulatory initiatives that may affect the outlook for US coal are also discussed. 10 figs., 14 tabs.

33153 (DOE/EIA–0363(89)) **Annual prospects for world coal trade 1989.** USDOE Energy Information Administration, Washington, DC (USA). Office of Coal, Nuclear, Electric and Alternate Fuels. 18 May 1989. 112p. Sponsored by DOE Management & Administration. Order Number DE89014644/JAW. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

Section 205(a)(2) of the Department of Energy Organization Act (Public Law 95-91) requires the Administrator of the energy Information Administration (EIA) to carry out a central, comprehensive, and unified energy data information program that will collect, evaluate, assemble, analyze, and disseminate data and information relevant to energy resources, reserves, production, demand, technology, and related economic and statistical information. To meet these responsibilities in the area of coal export analysis and to aid the reader in understanding the circumstances surrounding US coal exports, the EIA prepared this report. The international data in this report reflect material obtained from the Organization for Economic Cooperation and Development, the International Energy Agency, and foreign governments, and from presentations at international coal conferences and coal trade publications. As such, these data are not validated EIA data, but nonetheless provide historical and prospective information about the international coal market. 13 figs., 13 tabs.

0160 Health and Safety

Refer also to citation(s) 34435

02 PETROLEUM

33154 (DOE/BC/14126–7) **An introduction to computerized x-ray tomography for petroleum research.** Castanier, L.M. Stanford Univ., CA (USA). Petroleum Research Inst. Jun 1989. 24p. Sponsored by DOE Fossil Energy. DOE Contract FG22-87BC14126. (SUPRI-TR–66). Order Number DE89000752/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This report summarizes the state of the art in the application of medical tomography (CT) to petroleum recovery problems. A brief review of the basic principles of x-ray computerized tomography is followed by a discussion of the governing equations of the method. Calculation techniques and appropriate correlations for continued testing are described and discussed. A review of existing medical software is done. Consideration of the specific software needed for petroleum engineering as well as applications of new technologies such as image processing and computer networking are described. Criteria for the choice of a machine suitable for most petroleum-related applications are given. Emphasis is placed on flexibility, reliability, accuracy and price of the scanner. Two separate sections discuss positioning of the core and design of the core holders. Examples of possible applications of CT scanning to problems of geology, core analysis, EOR as well as operational process problems are discussed. 9 refs., 8 figs., 1 tab.

0202 Geology and Exploration

33155 (BNL–42769) **Hydrocarbon precombusting catalyst survey and optimization for perfluorocarbon tracer analysis in subsurface tracer applications.** Senum, G.I.; Cote, E.A.; D'Ottavio, T.W.; Dietz, R.N. Brookhaven National Lab., Upton, NY (USA). May 1989. 34p. Sponsored by DOE Energy Research. DOE Contract AC02-76CH00016. Order Number DE89014185/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The extension of the perfluorocarbon tracer (PFT) technology, as developed for atmospheric dispersion and transport studies to petroleum reservoir characterization studies, required the development of a more robust catalyst to remove analysis interferents caused by the adsorption of 5 liter hydrocarbon reservoir gas samples containing PFT onto carbonaceous adsorbent samplers. Two approaches were studied: (1) replacement of the present internal laboratory PFT analysis system catalyst with a more effective catalyst and, if this was not viable, (2) development of an external preprocessing catalyst train, to significantly reduce the hydrocarbon levels in the sample, without affecting the perfluorocarbon tracers. 13 figs., 13 tabs.

33156 (SAND–89-1435C) **Influence of lithology and geologic structure on in situ stress: Examples of stress heterogeneity in reservoirs.** Teufel, L.W. Sandia National Labs., Albuquerque, NM (USA). 1989. 17p. Sponsored by DOE Fossil Energy. DOE Contract AC04-76DP00789. (CONF-890620–1: 2. international reservoir characterization technical conference, Dallas, Texas, USA, 25-28 Jun 1989). Order Number DE89014692/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Knowledge of in situ stress is increasingly understood to be an important factor in formulating a multidisciplinary approach to reservoir characterization, and in the development and completion of oil and gas reservoirs. Two examples are presented to illustrate the influence of lithology and geologic structure on the distribution and heterogeneity of stress at depth. Stress measurements made in flat-lying, tight gas sandstone reservoirs and bounding mudstone formations of the Mesaverde Group in the Piceance Basin of Colorado show that principal horizontal stress magnitudes do not increase linearly with depth, solely as a function of the overburden, but vary with lithology. Minimum horizontal stresses in sandstone layers are more than 4 MPa less than adjacent mudstones. Stress measurements made in the Ekofisk Field in the North Sea demonstrate that principal horizontal stress directions are not uniform across a large structural dome, but are radial, with the azimuth of the maximum horizontal stress oriented perpendicular to the structural contours around the dome. These two examples indicate that in situ stress is not always defined by regional boundary conditions of a sedimentary basin, but is also affected by the local geological environment. 37 refs., 6 figs.

33157 **Distribution of regional fractures and fracture permeability controlled by sedimentological heterogeneities, Mesaverde Reservoirs, Colorado.** Lorenz, J.C. (Sandia National Labs., Albuquerque, NM (USA)); Finley, S.J. *AAPG (American Association of Petroleum Geologists) Bulletin (USA)*, 72(7): 875-876 (Jul 1988). (CONF-8808223–: AAPG Rocky Mountain Section meeting, Bismarck, North Dakota, USA, 21-24 Aug 1988).

Nonmarine sedimentation processes in lenticular Mesaverde sandstones of the Piceance basin, Colorado, created an irregular distribution of subunits within the present low-permeability reservoirs. The different lithologies have not only different porosities and permeabilities, but different mechanical and stress properties as

well. These strata were fractured during horizontal tectonic compression, creating a regional fracture system. Because of low stress conditions during fracturing, the extent and distribution of fractures were governed by the differences in rock properties, pore pressures, and in-situ stresses that were associated with the different reservoir heterogeneities. Well tests and laboratory measurements show that the fractures create economic (millidarcy) reservoirs out of submicrodarcy matrix rock. However, average fracture spacing and height - as measured in 4000 ft of core and observed in outcrop - are commonly less than gross bed thickness by a factor of at least 10, and fractures are irregularly distributed within the reservoirs. No fractures extend the full thickness of any sandstone greater than 6 ft thick, whereas most reservoirs of interest are 20-50 ft thick. Between 20 and 25% of all vertical fracture terminations in core occur within a reservoir sandstone at mudstone partings, rip-up clast or carbonaceous zones, or at sandstone grain-size changes. Another 10-35% occur at no apparent lithologic discontinuity. Both of these categories may represent en echelon offsets of the fractures beyond the 4-in. diameter core, but hydraulic continuity across an offset of the first type is doubtful. Forty to 70% of fracture terminations are at contacts between a sandstone and an adjacent thick mudstone, in large part because 80% of the observed fractures occur in sandstones that are less than 10 ft thick.

0203 Drilling and Production

33158 (CU/FCE–8903, pp. 16) **Identification of interwell communication in cyclic steam projects.** Bitter, B.S. (Petro-Canada, Inc., Canada); Leshchyshyn, T. Calgary Univ., AB (Canada). Faculty of Continuing Education. 1989. (CONF-8903126–: 6th Annual heavy oil and oil sands technical symposium, Calgary, Canada, 8 Mar 1989;CE–02591). In *Challenges and innovations 1989. 6th Annual heavy oil and oil sands technical sympposium.* Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages.

In multi-well cyclic steam projects, well interactions can have a dramatic impact on the recovery and ultimate success of the project. Therefore, it is extremely important that the development of inter-well communication be monitored closely. This paper reviews the types of well interactions: pressure transfer, matrix flooding, and fluid communication. Mechanisms for their development through fractures and fluid fingering are discussed. Characteristic phenomena of production and injection data associated with matrix flooding and fluid communication are identified. Frequent monitoring of Hall and Fracture Growth plots is identified as an effective means of monitoring the development and control of fluid communication in cyclic steam injection wells. This technique is particularly useful in large projects, where a lot of time can not be devoted to individual wells. 4 refs., 5 figs.

33159 (CU/FCE–8903, pp. 30) **Thermal screening criteria. Should they exist?.** Dugdale, P.J. (Petro-Canada Inc., Canada). Calgary Univ., AB (Canada). Faculty of Continuing Education. 1989. (CONF-8903126–: 6th Annual heavy oil and oil sands technical symposium, Calgary, Canada, 8 Mar 1989;CE–02591). In *Challenges and innovations 1989. 6th Annual heavy oil and oil sands technical symposium.* Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages.

A number of authors, as well as several institutions, have published screening criteria for thermal processes. These criteria are held by many as sacred, i.e., all criteria must be met before a process can be considered for a particular reservoir. Though the use of engineering judgement in the application of these criteria is advocated, they continue to be regarded as laws of nature and not as learned suggestions, based on successful projects. Examples are: it is inadvisable to steam less than 10 m of pay, or reservoirs at depths beyond 1000 m. Since many of the criteria used for the thermal processes-steam injection and in situ combustion are being violated by commercial operations, in particular in the oil sands, it was felt that an evaluation and discussion of each criterion was needed, especially in light of recent technological developments. This paper also discusses the laboratory and engineering efforts needed to properly match a process to a reservoir, as well as the piloting effort necessary to arrive at a commercial operation 55 refs., 5 figs., 4 tabs.

33160 (DOE/BC/14126–8) **SUPRI Heavy Oil Research Program: Twelfth annual report, October 1, 1987–September 30, 1988.** Brigham, W.E.; Castanier, L.M. Stanford Univ., CA (USA). Petroleum Research Inst. Jun 1989. 187p. Sponsored by DOE Fossil Energy. DOE Contract FG22-87BC14126. (SUPRI-TR–67). Order Number DE89000753/JAW. Available from NTIS, PC A09/MF A01 - OSTI; GPO Dep.

The following research programs on heavy oil recovery are presented: flow properties; in-situ combustion; steam injection with additives; reservoir definition; and field support services. Individual projects are processed separately for the data bases. (CBS)

33161 (NEI-NO–86) **Deepwater technology.** Norsk Petroleumsforening, Oslo. 1988. 181p. (CONF-8808151–: Offshore northern seas conference and exhibition, Stavanger, Norway, 23-26 Aug 1988). Order Number DE89776212/JAW. Available from NTIS (US Sales Only), PC A09/MF A01;1.

This section of the proceedings contains 13 papers covering the following topics: Habitat of oil and gas; A survey of deepwater petroliferous basins of the world; The deepwater environment - technical and economic challenges to successful operations; Challenges of equipment. Installation, retrieval and intervention; Flexible lines growing in use for deepwater developments; composite materials. An alternative to steel for offshore applications; Application of concrete to compliant structures for offshore development in deep waters; Campos basin floating production systems - technological development; Refinement of TLP designs for ultra deep water applications; The TDGI project - extending subsea development, control, and monitoring systems; Gullfaks field subsea completions experiences and lessons for the future; East Frigg subsea development - experience and lesson for the future; out on the horizon: Creating means to drill and produce beyond current water depth limitations. Separate abstracts were prepared for 3 papers of the section.

33162 (RF-SPS-A–24/85) **Working conditions and safety in drilling (Statoil). Work organization, technology and recruiting (NTNF).** Remoee, S.O.; Toennesen, T. Rogalandsforskning, Stavanger (Norway). Jun 1985. 20p. (In Norwegian). Order Number DE89776217/JAW. Available from NTIS (US Sales Only), PC A03/MF A01;1.

The aim of this paper has been to present a model for the future work organization in drilling. When developing such a model, both the physical and mental well being of the employees and other criterias of effectiveness have to be considered. We started out by presenting some of the short-comings of the usual technological and organizational arrangements in drilling. The probable technological development of the near future was presented. A lot of manual operations are now being transformed by mechanized equipment. Some routine operations are now being transformed by mechanized equipment. Some routine operations will be automated and computer based systems will be introduced, all of which requires new principles for the work organizaton. In addition, the Work Environment Act as well as productivity demands comprise a framework for effective organizational design. We have presented a model of a work organization in drilling which should satisfy the most important criteria of effectiveness. This will also move the drilling industry closer to the onshore industrial standards. The upgrading of skills and a basic technical education will help provide possibilities for offshore personnel to switch to onshore industrial work. We stress the strategic dimensions in the paper: It is of utmost importance to utilize and develop all available resources, technological, organizational and human, to reach a work organization which is effective for all interest groups. 2 drawings, 15 refs.

33163 Proceedings of the seventh international conference on offshore mechanics and Arctic engineering. Chung, J.S.; Sparks, C.P.; Brekke, J.N.; Clukey, E.C.; Penney, T.R. 557p. American Society of Mechanical Engineers, New York, NY (1988). (CONF-880205–: 7. international conference and exhibit on offshore mechanics and arctic engineering (OMAE-7), Houston, Texas, USA, 7-12 Feb 1988).

These proceedings collect papers given at a conference on offshore engineering. Topics include: fracture mechanics, vibration

testing, wave energy converters, ocean thermal energy converters, underwater pipelines, offshore platforms, and design and installation of permanent mooring systems for tankers.

33164 **Critical heterogeneities in a barrier island deposit and their influence on primary waterflood and chemical EOR operations.** Sharma, B. (Natl. Inst. for Petroleum and Energy Research (US)); Honarpour, M.M.; Szpakiewicz, M.J.; Schatzinger, R.A. v.v of Proceedings of the SPE Rocky Mountain regional meeting. Society of Petroleum Engineers, Richardson, TX (1988). (CONF-880573–: Society of Petroleum Engineers Rocky Mountain regional meeting, Casper, Wyoming, USA, 11-13 May 1988).

Geological heterogeneities controlling fluid production in a barrier island deposit were investigated from analysis of core, log, and production data from Bell Creek field in Montana. Distribution of barrier island facies and their relationships to adjacent environments of deposition were outlined. The reservoir was defined by grouping productive and non-productive facies documented in cores into three classes according to their storage capacity and transmissivity to fluids. Based on detailed core and log correlations, a structure contour map at the inferred top of the barrier island sandstone and an isopach map of barrier island sandstone were constructed to delineate the barrier island reservoir of Bell Creek field. These maps suggest that faulting and valley incisions may occur within certain localized areas of the barrier island deposit. Valley fill deposits unconformable overlying the reduced barrier island sequence have been documented in cores examined from Bell Creek field. These heterogeneities may affect oil production by reducing pay thickness, or by acting as permeability barriers, or even by providing high-permeability conduits for fluid flow if fracturing occurred in association with faulting.

33165 **Mathematical modeling of high pH chemical flooding.** Bhuyan, D. (Univ. of Texas (US)); Lake, L.W.; Pope, G.A. v.v of Proceedings of the SPE Rocky Mountain regional meeting. Society of Petroleum Engineers, Richardson, TX (1988). (CONF-880573–: Society of Petroleum Engineers Rocky Mountain regional meeting, Casper, Wyoming, USA, 11-13 May 1988).

This paper describes a generalized compositional reservoir simulator for high-pHG chemical flooding processes. This simulator combines the reaction chemistry associated with these processes with the extensive physical and flow property modeling schemes of an existing micellar/polymer flood simulator (UTCHEM). The formulation of the chemical equilibrium model is quite general and is adaptable to simulate different chemical systems. The scope of the model is illustrated by applying it to six different cases of high-pH chemical floods which include cases from a simple alkaline preflush to surfactant enhanced alkaline-polymer flooding.

0204 Processing

Refer also to citation(s) 33043, 33044, 33045, 33059, 33070, 33071, 33082, 33088, 33094, 33112, 33212

33166 (CONF-880604–17) **Stable carbon isotope analysis of coal/petroleum coprocessing products.** Winshel, R.A.; Burke, F.P. Consolidation Coal Co., Library, PA (USA). Research and Development Dept. 1988. 9p. Sponsored by DOE Fossil Energy. DOE Contract AC22-84PC70018. From Joint meeting of the 195th national meeting of the American Chemical Society and the 3rd Chemical Congress of North America; Toronto, Canada; 5-10 Jun 1988. Order Number DE89013143/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Coprocessing involves the simultaneous upgrading of coal and petroleum resid by catalytic hydroconversion. To obtain a kinetic/mechanistic description of the process, it is useful if not necessary to be able to distinguish the relative contributions of coal and petroleum to the product mixtures. In this paper, the method of stable carbon isotope ratio analysis is shown to be sufficiently sensitive to determine the relative concentrations of coal and petroleum carbon in coprocessing products. Selective isotopic fractionation does not appear to occur to a significant extent, although additional work is needed to confirm this preliminary conclusion. Application of the method to the coprocessing of Wyodak and Illinois 6 coals with a Lloydminster resid by the Signal research/UOP process is shown to yield valid results of use in process interpretation and optimization. 4 refs., 2 figs., 4 tabs.

33167 (CONF-8710113–2) **Coal and petroleum reactions in coal/oil coprocessing.** Winschel, R.A.; Burke, F.P. Consolidation Coal Co., Library, PA (USA). Research and Development Dept. 1987. 11p. Sponsored by DOE Fossil Energy. DOE Contract AC22-84PC70018. From DOE direct liquefaction contractors' review meeting; Pittsburgh, Pennsylvania, USA; 6-8 Oct 1987. Order Number DE89013145/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Coprocessing involves the simultaneous upgrading of coal and petroleum resid by catalytic hydroconversion. To obtain a kinetic/mechanistic description of the process, it is useful if not necessary to be able to distinguish the relative contributions of coal and petroleum to the product mixtures. In this paper, the method of stable carbon isotope ratio analysis is shown to be sufficiently sensitive to determine the relative concentrations of coal and petroleum carbon in coprocessing products. Selective isotopic fractionation does not occur to a significant extent, although additional work is needed to conform this preliminary conclusion. Application of the method to the coprocessing of Wyodak and Illinois 6 coals with a Lloydminster resid by the Signal Research/UOP process is shown to yield valid results of use in process interpretation and optimization. 4 refs., 2 figs., 4 tabs.

33168 (PB–89-137327/XAB) **Preliminary site visit report, Farmer's Valley Refinery, Bradford, PA. Control technology assessment of petroleum refinery operations, September 23, 1981.** Radian Corp., Salt Lake City, UT (USA). Feb 1982. 34p. Available from NTIS, PC A03/MF A01.

A visit was made to Farmer's Valley Refinery, near Bradford, Pennsylvania to evaluate control techniques used to limit worker exposure to hazardous chemical and physical agents. Engineering controls, monitoring, personal protective equipment, and work practices were discussed for each of several areas of the workplace. For the methyl-ethyl-ketone (MEK) dewaxing unit the engineering controls include an ammonia refrigeration building housing the ammonia compressors and controls. The wax filter building was enclosed and had four rotary vacuum filters on the second floor and pumps on the first. Adjacent to this building was the solvent-recovery area which was open and contained a number of steam stripping towers. The inert gas generator was located at the end of the solvent recovery area. Draeger tube monitoring was conducted for hydrocarbons, MEK, toluene and ammonia. Personal protective clothing was not used in this unit. For furfural extraction, the unit was completely open except for the brick pump control room. No continuous monitoring of this area was conducted. No special personal protective clothing was typically used. For bauxite filtering, the unit was located adjacent to the MEK-T unit and enclosed in a large metal building. Engineering controls included the use of clay filters and pressure vessels. Personnel wore half mask dust respirators. Control measures used at the blending and packaging plant were also described.

33169 (PB–89-137335/XAB) **Preliminary site visit report, UOP (Universal Oil Products) engineering offices: control-technology assessment of petroleum-refinery operations, Des Plains, Illinois, June 2, 1982.** Radian Corp., Salt Lake City, UT (USA). Sep 1982. 50p. (ECTB–102-01A). Available from NTIS, PC A03/MF A01.

Color illustrations reproduced in black and white.

A visit was made to Universal Oil Products, Inc. (UOP), Des Plaines, Illinois to assess the control methods used at this facility to protect workers from harmful exposures to chemical and physical agents. Specific attention was given to control methods for hydrogen fluoride (HF) alkylation units. Engineering controls included curbs around equipment to prevent acid spills from contaminating surrounding areas, the drainage of surface liquids into a neutralization pit, the scrubbing of all vent streams leaving the HF units with a potassium hydroxide scrubber to neutralize any HF present, the provision of emergency shower booths, and the installation of a sieve dryer to remove water in entering feed. A point was developed for joints, flanges, and valves of the alkylation unit; originally the paint was orange, but on exposure to HF it turned bright yellow. Protective clothing offered included face shields, gauntlets, rubbers,

booths, acid-resistant jackets, overalls, acid hoods, or complete pressurized suits. Work practices were carefully rehearsed so as to avoid accidental exposures. Workers were trained in safety measures, spill cleanups and washdowns, how to neutralize, and proper equipment-tagging procedures. Additional information was provided concerning emergency booths, the use of protective clothing, alkylation change houses, and safety procedures.

33170 (PB–89-137459/XAB) **Health-hazard evaluation determination report No. 77-47-427, Union 76 Oil Company, Nederland, Texas.** Burroughs, G.E. National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Sep 1977. 11p. (HHE–77-047-427). Available from NTIS, PC A03/MF A01.

A Health Hazard Evaluation investigation was conducted by NIOSH on April 5-7, 1977 at the Union 76 Oil Refinery near Nederland, Texas. The survey was prompted by a request from a representative of the approximately 700 'affected' employees who were thought to be exposed to a variety of chemical fumes. Environmental sampling for benzene, toluene, xylene, cyclohexane, methyl ethyl ketone, hexane, heptane, ammonia, sulfuric acid, and sodium hydroxide indicated that the employees were not exposed to potentially toxic concentrations of these materials. However, several of the samples analyzed for benzene were near the exposure limit recommended by NIOSH. For this reason, continued monitoring of atmospheric contaminants, particularly benzene, is recommended.

0205 Products and By-products

Refer also to citation(s) 33179

0207 Marketing and Economics

33171 (DOE/EIA–0340(88/2)) **Petroleum supply annual 1988: Volume 2.** USDOE Energy Information Administration, Washington, DC (USA). Office of Oil and Gas. 5 Jun 1989. 450p. Sponsored by DOE Management & Administration. Order Number DE89013818/JAW. Available from NTIS, PC A20/MF A01 - GPO - OSTI; GPO Dep.

The Petroleum Supply Annual (PSA) contains information on the supply and disposition of crude oil and petroleum products. The publication reflects data that were collected from the petroleum industry during 1988 through annual and monthly surveys. The PSA is divided into two volumes. This first volume contains two sections, US Petroleum Supply and Refinery Capacity, each with final annual data. The second volume contains final statistics for each month of 1988, and replaces data previously published in the Petroleum Supply Monthly (PSM). The tables in Volumes 1 and 2 are similarly numbered to facilitate comparison between them. Explanatory Notes, located at the end of this publication, present information describing data collection, sources, estimation methodology, data quality control procedures, modifications to reporting requirements and interpretation of tables. Industry terminology and product definitions are listed alphabetically in the Glossary.

33172 (DOE/EIA–0380(89/03)) **Petroleum marketing monthly, March 1989.** Office of Oil and Gas, Washington, DC (USA). 7 Jun 1989. 184p. Sponsored by DOE Management & Administration. Order Number DE89013478/JAW. Available from NTIS, PC A09/MF A01 - GPO - OSTI; GPO Dep.

The Petroleum Marketing Monthly (PMM) is designed to give information and statistical data about a variety of crude oils and refined petroleum products. The publication provides statistics on crude oil costs and refined petroleum products sales for use by industry, government, private sector analysts, educational institutions, and consumers. Data on crude oil include the domestic first purchase price, the f.o.b. and landed cost of imported crude oil, and the refiners' acquisition cost of crude oil. Sales data for motor gasoline, distillates, residuals, aviation fuels, kerosene, and propane are presented.

33173 (DOE/EIA–0384(88)) **Annual energy review, 1988.** USDOE Energy Information Administration, Washington, DC (USA). Office of Energy Markets and End Use. 23 May 1989. 309p. Sponsored by DOE Management & Administration. Order Number DE89012601/JAW. Available from NTIS, PC A14/MF A01 - GPO - OSTI; GPO Dep.

Historical and current data on production, consumption, stocks, imports, exports, and prices of the principal energy commodities in the United States are presented. Also included are data on international production of crude oil, consumption of petroleum products, petroleum stocks, and production of electricity from nuclear-powered facilities.

33174 (NEI-NO–88) **Oil pricing.** Norsk Petroleumsforening, Oslo. 1988. 33p. (CONF-8808151–: Offshore northern seas conference and exhibition, Stavanger, Norway, 23-26 Aug 1988). Order Number DE89776214/JAW. Available from NTIS (US Sales Only), PC A03/MF A01;1.

This section of the proceedings contains only one available paper covering the following topic Oil price and demand interactions. No separate abstract was prepared for this paper.

0208 Waste Management

Refer also to citation(s) 33768, 34054

0209 Environmental Aspects

Refer also to citation(s) 33168, 33169, 33170, 33177

33175 (PB–89-855803/XAB) **Oil spill removal: dispersants, absorbants, booms, and skimmers. January 1978-January 1989 (Citations from the Life Sciences Collection data base). Report for January 1978-January 1989.** National Technical Information Service, Springfield, VA (USA). Feb 1989. 105p. Available from NTISPC N01/MF N01.

Supersedes PB–86-856226.

This bibliography contains citations concerning the techniques available for the removal of oil following major spills. Chemical dispersants, gelling agents, foam plastics, booms, skimmers, and burning are discussed. Specific oil spills are considered and the environmental impacts of oil spills are noted. (This updated bibliography contains 198 citations, 20 of which are new entries to the previous edition.)

33176 (SNV–3169) **Municipal emergency planning for oil spills at sea. Manual of municipal preparedness.** Svenska Kommunfoerbundet, Stockholm (Sweden); National Swedish Environmental Protection Board, Solna (Sweden). 1986. 86p. (In Swedish). Order Number DE89776222/JAW. Available from NTIS (US Sales Only), PC A05/MF A01;1.

The manual is adapted to Swedish municipalities organization and working conditions, our climate and our particular coast. Sweden has an extremely long coast to protect - nearly 9 000 miles along the mainland plus the beach zones on more than 100 000 islands. Big oil spills - spills of 500 tons or more - often mean a workforce and equipment intensive operation over a long period. Such big oil spills may occupy 100 to 200 persons for a whole year. Operations of this scale require co-ordinated efforts by many sectors of the municipal organization. The Swedish Association of Local Authorities recommends all municipalities where oil spills may occur to prepare emergency plans for dealing with them. Such emergency plans should consist of three parts; one organization plan, one operation plan, and one inventory of resources. The manual gives detailed suggestions of necessary functions as well as alternative proposals for the organization. There are also examples of operation plans. To assist the municipalities in their planning work the manual gives figures for the scale of operations based on experience from prior oil disasters. During the first stages one must reckon with large oil residues capable of being pumped into tank-barges (400 cu.m) at the rate of one every 4-5 hours. (The first tank-barge will arrive at the earliest 24 hours after the alarm) The total quantity is presupposed to be at the most 2 500 cu.m. The manual describes the H.Q. and its equipment, the stores needed, for the workforce, the workshops and facilities. The manual also describes the type of equipment needed to handle the oil during the collection and loading, the discharging as well as at the temporary storage place. It describes methods of recycling and treatment of oil residues.

0210 Legislation and Regulation

Refer also to citation(s) 33660

0220 Transport, Pipelines, and Handling

33177 (PB–89-139042/XAB) **Causeways in the Alaskan Beaufort Sea. Final report.** Ross, B.D. Environmental Protection Agency, Anchorage, AK (USA). Alaska Operations Office. Oct 1988. 35p. (EPA–910/9-88/218). Available from NTIS, PC A03/MF A01.

This report reviews information from several years of permit-required field monitoring of the physical and biological effects of solid-fill gravel causeways in the Beaufort Sea near Prudhoe Bay, Alaska. The shallow near-shore zone of the Beaufort Sea coast in the Prudhoe Bay area functions biologically as an estuary. Area anadromous fish rely heavily upon the comparatively moderate estuarine conditions in this zone. Prudhoe Bay area causeways have been constructed across this critical zone, degrading the nearshore estuarine environment by: (1) deflecting fresh and brackish water masses offshore, resulting in the loss of thermal energy and fresh water from the nearshore; (2) causing enhanced upwelling and intrusion of marine water directly into the nearshore zone in replacement of the deflected estuarine water; and (3) affecting local ice dynamics. These physical effects increase the risks that populations of anadromous fish will be seriously affected by increased over-winter mortalities, reduced growth and fecundity, and/or delayed maturation. Evidence that these impacts may already have begun to occur is discussed. Construction of additional causeways in the area would further increase these risks.

0230 Properties

Refer also to citation(s) 33118, 33119, 33124, 34046, 34072

33178 (NIPER–82) **Thermodynamic properties of biphenyl: Topical report.** Chirico, R.D.; Knipmeyer, S.E.; Nguyen, A.; Steele, W.V. National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA). Jun 1989. 51p. Sponsored by DOE Fossil Energy. DOE Contract FC22-83FE60149. Order Number DE89000750/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

Ideal-gas thermodynamic properties for biphenyl based on accurate calorimetric measurements were determined between 300 and 700 K, well into the range of typical chemical process temperatures. The calorimetrically derived values provide a firm basis for the prediction of thermodynamic properties for a large family of molecular structures including many substituted biphenyls (such as PCB's) as well as polyphenyls of arbitrary size. Also, results highlighted ambiguities common in the statistical calculation of thermodynamic properties of polycyclic molecules. Critical-property measurement using a differential scanning calorimeter (DSC) showed the commonly accepted assessed value to be in error. This value serves as a "cornerstone" in group-contribution critical property estimation schemes, which often are employed by engineers in corresponding-states correlations for the estimation of a great variety of physical properties. Thermodynamically-consistent sublimation vapor pressures were derived to show which of the many literature values are valid; an essential step in the validification of the many reported PCB vapor-pressure measurements, which are key to environmental-impact considerations. Derived Gibbs energies of formation allow the calculation of chemical equilibria in the biphenyl/hydrogen reaction network (published in a companion report; Topical report NIPER-403), which has important ramifications in alternate fuel processing. 85 refs., 11 figs., 16 tabs.

33179 (NIPER–415) **Thermodynamics and the hydrodenitrogenation of indole: Part 1, Thermodynamic properties of indoline and 2-methylindole: Part 2, Gibbs energies of reaction in the hydrodenitrogenation of indole: Part 3, Thermodynamic equilibria and comparison with literature kinetic.** Steele, W.V.; Chirico, R.D. National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA). Jun 1989. 84p. Sponsored by DOE Fossil Energy. DOE Contract FC22-83FE60149. Order Number DE89000751/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

Ideal-gas thermodynamic properties for indoline and 2-methylindole based on accurate calorimetric measurements (between 300 to 500 K and 300 to 700 K, respectively) were determined; well into the range of typical chemical process temperatures. The calorimetrically derived values provide a firm basis for the prediction of thermodynamic properties for a large family of structures including many substituted indoles and indolines. Critical-temperature/density measurements obtained using a differential scanning calorimeter (DSC) are reported for 2-methylindole. A critical pressure and acentric factor are derived for 2-methylindole. Group-additivity estimation methods are employed to estimate the Gibbs energies of formation for the reactants, intermediates, and products in a reaction scheme for the hydrodenitrogenation (HDN) of indole. Thermodynamic equilibria calculations on the indole/indoline/hydrogen system are compared with experimental batch-reaction measurements reported in the literature. The interplay between thermodynamics and kinetics in the HDN of indole is discussed. 41 refs., 11 figs., 23 tabs.

33180 Neutron-induced vaporization of superheated liquids. Apfel, R.E. (Dept. of Mechanical Engineering, Yale Univ., New Haven, CT (US)). v.v of Phase transitions in condensed systems - experiments and theory. Cargill, G.S. III; Spaepen, F.; Tu, K.N. Materials Research Society, Pittsburgh, PA (1987). (CONF-851260–: Symposium on phase transitions in condensed systems: experiments and theory, Boston, Massachusetts, USA, 2-7 Dec 1985).

The authors interest in neutron-induced nucleation began with a simple and elegant demonstration in one of David Turnbull's classes in which a drop of water was superheated to about 250^{0}C as it rose in a column of heated oil. As David Glaser, the inventor of the bubble chamber, so ably demonstrated, such superheated liquids are radiation sensitive. Halocarbon and hydrocarbon drops are introduced into an aqueous holding gel under pressure at room temperature. As the pressure is released, the drops become superheated. Neutrons of sufficient energy will trigger vaporization of these moderately superheated drop detectors (SSDs), but gammas and x-rays will not unless the homogeneous nucleation limit is approached. The authors have performed measurements on the neutron energy threshold to produce nucleation in a number of different superheated materials at different temperatures. The authors have also developed a theory which indicates that of the energy deposited in a critical radius, only about 5% is effective in producing bubble formation. Both theory and experiment are discussed.

0250 Combustion

Refer also to citation(s) 33145, 33160

33181 (NEI-FI–77) **Combustion of water/heavy fuel oil emulsions and oil.** Kaukanen, E.; Pyykkoenen, A. Enconsults Oy, Kaarina (Finland). 1988. 72p. (In Finnish). Order Number DE89776165/JAW. Available from NTIS (US Sales Only), PC A04/MF A01;1.

This report deals with the emissions of residual oil (oil) and water/oil emulsion (emulsion) combustion. To investigate the effect of emulsion water contents on the emissions of particulates, NO and SO_2, as series of experiments was conducted at the NESTE OY Combustion Laboratory, Skoeldvik 5.-21. October 1987. A 1.5 MW boiler, a burner which modulates a pressurejet atomizer, and a water/oil emulsion apparatus. Preliminary investigation demonstrated the necessity to study emulsion combustion by changing one parameter at a time in order to optimize the process for minimum particulate emissions and maximum efficiency. The experimental results show clearly, that emulsion combustion produsd less particulate emissions than oil combustion. In oil combustion the average particulate emission was 135 mg/m^{3}n, and in emulsion combustion, with 8.9% water added, 93 mg/m^{3}n. The particle size distribution was also affected. Coarse particle (> 4 μm) emissions were reduced strongly, while fine particle (< 4 μm) remained unaffected. The average particle size was therefore much smaller in emulsion combustion (3.4 μm) than oil combustion (5.1 μm). Emulsion had no effect on the emissions of NO and SO_2.

33182 A general procedure for constructing reduced reaction mechanisms with given independent relations. Chen, J.Y. (Sandia Nat. Labs., Livermore, CA (US)). v.v of The Combustion Institute joint conference: Western states and Japanese sections (Extended Abstracts). Combustion Institute, Pittsburgh, PA (1988). (CONF-871118–: Combustion Institute joint fall meeting: Western states and Japanese sections, Honolulu, Hawaii, USA, 22-25 Nov 1987).

Simplification of a detailed reaction mechanism is possible if there exists independent, approximate relations which permit calculation of concentrations of some species in terms of other known concentrations. Given these independent relations, a general procedure has been developed for combining a set of elementary chemical reactions into a reduced mechanism.

33183 Flammability limits in cocurrent smoldering combustion. Dosanjh, S.S. (Sandia Nat. Labs., Albuquerque, NM (US)). v.v of The Combustion Institute joint conference: Western states and Japanese sections (Extended Abstracts). Combustion Institute, Pittsburgh, PA (1988). (CONF-871118–: Combustion Institute joint fall meeting: Western states and Japanese sections, Honolulu, Hawaii, USA, 22-25 Nov 1987).

The effect of heat losses on cocurrent (premixed-flame-like) smoldering combustion is investigated using activation energy asymptotics. Expressions are derived for the smolder velocity and the maximum temperature. Flammability limits are discussed.

33184 Computer simulation of the burning of a multicomponent droplet. Flatbush, E.K. (Sandia Nat. Labs., Livermore, CA (US)); Dwyer, H.A. v.v of The Combustion Institute joint conference: Western states and Japanese sections (Extended Abstracts). Combustion Institute, Pittsburgh, PA (1988). (CONF-871118–: Combustion Institute joint fall meeting: Western states and Japanese sections, Honolulu, Hawaii, USA, 22-25 Nov 1987).

This paper investigates the burning of two-component fuels with a one-dimensional computer model of droplet combustion. The combustion of multi-component fuels is significantly more complex that that of single fuels, but its study has the potential of revealing new ways to improve combustion efficiency. For example, poorly burning fuels may be improved by adding a second, highly combustible component to promote ignition. If this additive was volatile and easily ignited, it might provide the heat to initiate ignition of the main fuel. Experimental work has shown that a heavily chlorinated hydrocarbon droplet which normally does not burn can be burned by adding a small amount of alkane fuel. The burning characteristics of two-component droplets have been studied by earlier computer models.

03 NATURAL GAS

33185 (NEI-NO–84) **General conference.** Norsk Petroleumsforening, Oslo. 1988. 177p. (CONF-8808151–: Offshore northern seas conference and exhibition, Stavanger, Norway, 23-26 Aug 1988). Order Number DE89776210/JAW. Available from NTIS (US Sales Only), PC A09/MF A01;1.

This section of the proceedings contains eight papers covering the following topics: energy to the world; gas as a global energy source; the European market; foreign markets for LNG: United States versus Japan - what went right, what went wrong?; Gas challenges in a competitive market; gas market structures in Western Europe, visions for the Northern Waters; gas versus oil = similarities and differences. Separate abstracts were prepared for 2 papers of the section.

0302 Geology and Exploration

Refer also to citation(s) 33193, 33199

33186 (DOE/MC/20422–2691) **Geochemical and geologic factors effecting the formulation of gas hydrate: Task No. 5, Final report.** Kvenvolden, K.A.; Claypool, G.E. Geological Survey, Menlo Park, CA (USA). Jan 1988. 50p. Sponsored by DOE Fossil Energy. DOE Contract AI21-83MC20422. Order Number DE89000985/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

The main objective of our work has been to determine the primary geochemical and geological factors controlling gas hydrate information and occurrence and particularly in the factors responsible for the generation and accumulation of methane in oceanic gas hydrates. In order to understand the interrelation of geochemical/geological factors controlling gas hydrate occurrence, we have undertaken a multicomponent program which has included (1) comparison of available information at sites where gas hydrates have been observed through drilling by the Deep Sea Drilling Project (DSDP) on the Blake Outer Ridge and Middle America Trench; (2) regional synthesis of information related to gas hydrate occurrences of the Middle America Trench; (3) development of a model for the occurrence of a massive gas hydrate as DSDP Site 570; (4) a global synthesis of gas hydrate occurrences; and (5) development of a predictive model for gas hydrate occurrence in oceanic sediment. The first three components of this program were treated as part of a 1985 Department of Energy Peer Review. The present report considers the last two components and presents information on the worldwide occurrence of gas hydrates with particular emphasis on the Circum-Pacific and Arctic basins. A model is developed to account for the occurrence of oceanic gas hydrates in which the source of the methane is from microbial processes. 101 refs., 17 figs., 6 tabs.

33187 (DOE/MC/20422–2692) **Geologic interrelations relative to gas hydrates within the North Slope of Alaska: Task No. 6, Final report.** Collett, T.S.; Bird, K.J.; Kvenvolden, K.A.; Magoon, L.B. Geological Survey, Menlo Park, CA (USA). Jan 1988. 150p. Sponsored by DOE Fossil Energy. DOE Contract AI21-83MC20422. Order Number DE89000986/JAW. Available from NTIS, PC A07/MF A01 - OSTI; GPO Dep.

The five primary objectives of the US Geological Survey North Slope Gas Hydrate Project were to: (1) Determine possible geologic controls on the occurrence of gas hydrate; (2) locate and evaluate possible gas-hydrate-bearing reservoirs; (3) estimate the volume of gas within the hydrates; (4) develop a model for gas-hydrate formation; and (5) select a coring site for gas-hydrate sampling and analysis. Our studies of the North Slope of Alaska suggest that the zone in which gas hydrates are stable is controlled primarily by subsurface temperatures and gas chemistry. Other factors, such as pore-pressure variations, pore-fluid salinity, and reservior-rock grain size, appear to have little effect on gas hydrate stability on the North Slope. Data necessary to determine the limits of gas hydrate stability field are difficult to obtain. On the basis of mud-log gas chromatography, core data, and cuttings data, methane is the dominant species of gas in the near-surface (0–1500 m) sediment. Gas hydrates were identified in 34 wells utilizing well-log responses calibrated to the response of an interval in one well where gas hydrates were actually recovered in a core by an oil company. A possible scenario describing the origin of the interred gas hydrates on the North Slope involves the migration of thermogenic solution- and free-gas from deeper reservoirs upward along faults into the overlying sedimentary rocks. We have identified two (dedicated) core-hole sites, the Eileen and the South-End core-holes, at which there is a high probability of recovering a sample of gas hydrate. At the Eileen core-hole site, at least three stratigraphic units may contain gas hydrate. The South-End core-hole site provides an opportunity to study one specific rock unit that appears to contain both gas hydrate and oil. 100 refs., 72 figs., 24 tabs.

0303 Drilling, Production, and Processing

Refer also to citation(s) 33163, 33196

33188 (DOE/EIA–0130(89/03)) **Natural gas monthly, March 1989.** USDOE Energy Information Administration, Washington, DC (USA). Office of Oil and Gas. 23 May 1989. 147p. Sponsored by DOE Management & Administration. NONE - EIA. Order Number DE89013213/JAW. Available from NTIS, PC A07/MF A01 - GPO - OSTI; GPO Dep.

Gross withdrawals of natural gas (wet, after lease separation) from gas and oil wells in the United States during March 1989, were estimated at 1777 billion cubic feet, 0.4 percent below withdrawals during March 1988. Of the total quantity, an estimated 211 billion cubic feet were returned to gas and oil reservoirs for repressuring,

pressure maintenance, and cycling; 36 billion cubic feet of nonhydrocarbon gases were removed; and 12 billion cubic feet were vented or flared. The remaining wet marketed production totaled 1518 billion cubic feet. Dry gas production (wet marketed production minus 71 billion cubic feet of extraction loss) totaled an estimated 1447 billion cubic feet, similar to the March 1988 level. The total dry gas supply available for disposition in March 1989 was estimated at 1881 billion cubic feet, including 319 billion cubic feet withdrawn from storage, 14 billion cubic feet of supplemental supplies, and 101 billion cubic feet that were imported. In March 1988, dry gas available for disposition totaled 1841 billion cubic feet. Of the total dry gas supply available for disposition in March 1989, an estimated 1837 billion cubic feet were consumed, 93 billion cubic feet were injected into underground storage reservoirs and 8 billion cubic feet were exported, leaving 57 billion cubic feet unaccounted for.

0304 Products and By-products

33189 (NEI-NO–87) **Gas utilization.** Norsk Petroleumsforening, Oslo. 1988. 115p. (CONF-8808151–: Offshore northern seas conference and exhibition, Stavanger, Norway, 23-26 Aug 1988). Order Number DE89776213/JAW. Available from NTIS (US Sales Only), PC A06/MF A01;1.

This section of the proceedings contains 11 papers covering the following topics: Use of gas in power generation in IEA countries; Technical/economic aspects of power generation based on natural gas; Gas energy transport and distribution; Natural gas in power plants combines with district heating; Case study: introduction of power generation based on natural gas into a highly developed hydro power system; Development in natural gas conversion to transport fuel - a review; Conversion of natural gas to methanol; Mobil technologies for upgrading methanol to hydrocarbons; Technical/commercial review of the development of middle distillate synthesis of natural gas to transport fuel; Case study: prospects for a natural gas based plant for combined power generation and gas conversion. Separate abstracts were prepared for 5 papers of the section.

0306 Marketing and Economics

Refer also to citation(s) 33188, 33198, 33741

33190 (PB–89-140867/XAB) **Process-integration methodology for natural-gas-fueled heat pumps and cogeneration systems. Final report, March 1987-October 1988.** Rossiter, A.P. ICI-TENSA Services, Houston, TX (USA). Nov 1988. 338p. Available from NTIS, PC A15/MF A01.

The objective of the project was to develop a process-integration methodology for analyzing industrial processes, identifying those that will benefit from natural-gas-fueled heat pumps and cogeneration system as well as novel, process-specific opportunities for further equipment improvements, including performance targets. The development included the writing of software to assist in implementing the methodology and application of the procedures in studies using both literature data and plant-operating data. These highlighted potential applications for gas-fueled heat pumps in ethylene processes and liquor-distilling plants, and slightly less-attractive opportunities in a number of other plants. Many of the processes studied showed excellent potentials for cogeneration applications. A particularly attractive novel cogeneration application was identified for a wet corn mill, in which the exhaust for a gas turbine can be used to provide exhaust heat in flash driers that handle non-food grade products.

33191 (PB–89-140875/XAB) **Research and development opportunities for natural-gas-fueled equipment for emerging industrial processes. Final report, March 1987-March 1988.** Shah, J.V. Linnhoff March, Inc., Leesburg, VA (USA). Aug 1988. 116p. Available from NTIS, PC A06/MF A01.

The study was undertaken to identify opportunities for the use of gas fueled cogeneration equipment in emerging industrial processes and to understand technical, economic, and institutional barriers to their use. A process owner has several design alternatives to cogeneration such as process heat recovery, modification of process equipment, and the use of heat pumps that can impact and serve as alternatives to cogeneration systems. To understand these alternatives, a new design method called Pinch Technology was used in this investigation. Over 30 emerging processes were surveyed from the paper and pulp, food, chemical, oil and gas, and waste-to-fuel industries. The study identified potential for the use of gas turbines in two new pulping processes and for the use of gas engines in food processing applications such as soybean oil plants.

33192 (PB–89-148894/XAB) **Glass industry: opportunities for natural gas technologies. Topical report, February 1987-September 1988.** Charles River Associates, Inc., Boston, MA (USA). Sep 1988. 124p. (CRA–208.02). Available from NTIS, PC A06/MF A01.

At the present time, natural gas is the principal energy source for melting glass and is also used for downstream operations. For melting, the industry prefers gas over oil because of its cleanliness and ease of control and over electric energy because of its lower cost. Electric energy is, however, used for mechanical drives (where gas cannot be substituted), for temperature boosting, and for downstream operations such as tempering and annealing (where gas but not oil could be substituted, assuming favorable economics). The industry is described in terms of its structure, markets, products, and financial strength. The available energy-consumption statistics, which are limited and generally inaccurately segmented by unit processes, product lines, and energy sources, were updated to define more effectively where and how energy is used in the U.S. glass industry.

0309 Artificial Stimulation

33193 (NMRDI–2-76-5317) **Rock matrix and fracture analysis of flow in western tight gas sands (Phase IV): 1988 annual report.** Morrow, N.R. New Mexico Inst. of Mining and Technology, Socorro, NM (USA). New Mexico Petroleum Recovery Research Center. May 1989. 91p. (PRRC–88-12). Available from OSTI - NMRDI Communications Office, Suite M, 457 Washington SE, Albuquerque, NM 87108.

This report contains petrographic data and information about pore quality and distribution for thin sections taken from thirty MWX (Multiwell) cores recovered from three different wells and four depositional environments. Data were acquired using both transmitted and epifluorescent light microscopy. Trends are noted relating sample composition and pore quality to depositional environments; various petrophysical properties and features visible in thin section are related. Four samples from the marine zone have been added to advanced core analysis results. Effects of acetic treatment on cores containing mineralized fractures were investigated. Chemical treatment to determine mineralogic controls over flow properties continues, with HCl, NaOH, and oxalic acid being utilized as the reagents. Capillary pressure measurements made by centrifugation and mercury injection experiments are compared for six samples. Data relating gas permeability to electrical conductivity are reported for five samples; brine permeability-formation factor relationships are reported for one of these samples. 19 refs., 34 figs., 9 tabs.

33194 (PB–89-142574/XAB) **Geologic evaluation of critical production parameters for coalbed methane resources. Part 1. San Juan Basin. Annual report, August 1987-July 1988.** Ayers, W.B.; Kaiser, W.R.; Swartz, T.E.; Zellers, S.D.; Scanlon, A.H. Texas Univ., Austin, TX (USA). Bureau of Economic Geology. Dec 1988. 115p. Available from NTIS, PC A06.

See also Part 2, PB–89-142582.

Thick Fruitland coal seams formed landward of Pictured Cliff shoreline sandstones as a result of a stillstand caused by subsidence along the San Juan Basin axis. Both Fruitland coal seams and upper Pictured Cliffs sandstones are elongate to the northwest, favoring fluid movement from that direction. Regional studies show two distinct hydrologic areas in the Fruitland Formation in the south region. Ground-water flow from both areas converges toward the San Juan River as the river exits the basin to the west. The transition from overpressuring to under-pressuring is marked by steepening of the potentiometric surface coincident with south-west pinch-out of thick coal seams and Pictured Cliffs sandstone tongues. Coalbed methane is produced from overpressured and underpressured Fruitland coal seams, and Fruitland coal seams and sandstones are in hydraulic communication.

33195 (PB–89-142582/XAB) **Geologic evaluation of critical production parameters for coalbed methane resources. Part 2. Black Warrior Basin. Annual report, August 1987-July 1988.** Epsman, M.L.; Wilson, G.V.; Pashin, J.C.; Tolson, J.S.; Ward, W.E. Alabama Geological Survey, University, AL (USA). Dec 1988. 212p. Available from NTIS, PC A10.

See also Part 1, PB–89-142574.

Coal in the Brookwood and Oak Grove fields in Alabama generally ranges from low- to medium-volatile bituminous rank. Lithologic and stratigraphic evidence indicates that the coal was deposited in structurally influenced alluvial environments. Coal beds are thickest and easily mined on structurally stable, uplifted fault block and the coal beds thin and split in the more heavily faulted downdropped areas, which are amenable to coalbed degasification. In Brookwood field, mine dewatering and deep degasification zones may act in concert, causing upward movement of saline water along faults. In Oak Grove field, mine dewatering evidently creates areas of low fluid pressure and promotes downward movement of fresh water along faults. Production of methane is greatest in wells producing the most water. The method of well stimulation is of minor importance in Brookwood field, however, in Oak Grove field the water-sand-fracture method gives the highest initial-production rate. High-yield wells are located close to faults and lineaments. Lower productivity in Brookwood field may be related to venting of methane in nearby underground mines.

33196 (PB–89-146302/XAB) **Site selection for GRI (Gas Research Institute) cooperative tight-gas-field research. Volume 2. Geologic characteristics of selected low-permeability gas sandstones. Topical report, May-July 1988.** Baumgardner, R.W.; Tye, R.S.; Laubach, S.E.; Diggs, T.N.; Herrington, K.L. Texas Univ., Austin, TX (USA). Bureau of Economic Geology. Dec 1988. 236p. Available from NTIS, PC A11/MF A01.

Geological, engineering, and economic data on selected formations were compiled to provide a basis for siting the fourth Staged Field Experiment (SFE) for the Tight Gas Sands research program. The geologic units chosen are the Abo, Cleveland, and Frontier Formations, and the Mesaverde Group. Extrapolation potential is good for all formations except the Cleveland, whose thin deltaic package has no good analogy in other low-permeability sandstones. The Abo has the best potential for extrapolation to other low-permeability formations. Average thickness of reservoirs is about 250 ft in the Mesaverde and Abo, 160 ft in the Frontier, and 120 ft in the Cleveland. Deepest production depth varies from 4,750 ft (Abo) to 12,198 ft (Second Frontier sandstone). Estimated resource base ranges from 3 TCF (Abo) to 86 TCF (Mesaverde). Pre-stimulation production ranges from too small to measure (Cleveland, Frontier, Mesaverde) to 314 MCFD (Frontier). Post-stimulation production ranges from 3 MCFD (Mesaverde) to 12,250 MCFD (Cleveland). Permeability ranges from less than 0.0001 md (Frontier) to 1.3 md (Frontier). Natural fractures have been shown to be significant locally in the Mesaverde, but their contribution to reservoir permeability in the other formations is not well-documented.

33197 **Permeability damage to natural fractures caused by fracturing fluid polymers.** Gall, B.L. (Natl. Inst. for Petroleum and Energy Research (US)); Sattler, A.R.; Maloney, D.R.; Raible, C.J. v.v of Proceedings of the SPE Rocky Mountain regional meeting. Society of Petroleum Engineers, Richardson, TX (1988). (CONF-880573–: Society of Petroleum Engineers Rocky Mountain regional meeting, Casper, Wyoming, USA, 11-13 May 1988).

Formation damage studies using artificially fractured, low-permeability sandstone cores indicate that viscosified fracturing fluids can severely restrict gas flow through these types of narrow fractures. These studies were performed in support of the Department of Energy's Multiwell Experiment (MWX). The MWX program was a coordinated research effort to study methods to evaluate and enhance gas production from low-permeability and enhance gas production from low-permeability lenticular reservoirs of the Western United States. Extensive geological and production evaluations at the MWX site indicate that the presence of a natural fracture system is largely responsible for unstimulated gas production. The laboratory formation damage studies were designed to examine changes in cracked core permeability to gas caused by fracturing fluid residues introduced into such narrow fractures during fluid leakoff. The results of fluid leakoff tests indicated that polysaccharide polymers caused a filter cake buildup at or near the crack entrance while polyacrylamide polymers did not cause a filtercake buildup within the time period of the tests. For xanthan gum gels filtercake buildup was reduced for gels containing polymer breakers. For gels containing polymer breakers, 100 mesh sand was an effective fluid-loss control agent for narrow fractures.

0310 Legislation and Regulation

Refer also to citation(s) 33660

0320 Transport, Pipelines, and Handling

Refer also to citation(s) 33188, 33189

33198 (DOE/EIA–0525) **Growth in unbundled natural gas transportation services: 1982–1987.** USDOE Energy Information Administration, Washington, DC (USA). Office of Oil and Gas. 19 May 1989. 76p. Sponsored by DOE Management & Administration. Order Number DE89012937/JAW. Available from NTIS, PC A05/MF A01 - GPO - OSTI; GPO Dep.

The natural gas industry has undergone significant structural change since the passage of the Natural Gas Policy Act (NGPA) of 1978. Initially, the major impact of these changes was on the wellhead production market. Since 1982, however, major changes have affected downstream markets as well. This publication examines the evolution of the natural gas transportation market since 1982. During this period, interstate pipeline companies shifted their emphasis from the wholesaling of natural gas to that of providing transportation services. This major restructuring of the marketplace may be attributed to a combination of factors including the softening of demand, partial deregulation of prices, competition from other energy sources, and the development of a natural gas surplus. 9 figs., 17 tabs.

0330 Properties

33199 (PB–89-140834/XAB) **Two-phase flow in tight gas sands. Annual report, April 1987-May 1988.** Soeder, D.J.; Chowdiah, P. Institute of Gas Technology, Chicago, IL (USA). Dec 1988. 55p. Available from NTIS, PC A04/MF A01.

Tight sandstones typically contain a pore geometry consisting of either grain-supported primary porosity with flowpaths restricted by authigenic minerals, or a highly altered pore system composed of secondary solution pores interconnected by narrow linear slot pores between quartz overgrowths. Gas movement through these restrictive pores is quite sensitive to net confining stress and partial water saturation. Movement of gas and liquid phases simultaneously in tight gas sand occurs with difficulty because of the tendency for the liquid to block narrow flow-paths. Investigation of the Travis Peak Sandstone of eastern Texas revealed that deeper parts of the formation have many of the highly altered pore morphologies and petrophysical properties observed in tight gas sands of the Rocky Mountains, while shallower portions contain less altered pore geometries and correspondingly different petrophysical properties. The purpose of this study is to systematically identify the relationships between pore morphology, reservoir properties, and fluid flow through the matrix of low permeability sandstones to better assess reservoir quality.

33200 (PB–89-145080/XAB) **Nuclear magnetic resonance for measuring gas energy content. Final report, September 1986-April 1988.** King, J.D.; Rollwitz, W.L.; Nicholls, C.I. Southwest Research Inst., San Antonio, TX (USA). Apr 1988. 101p. Available from NTIS, PC A06/MF A01.

This research is directed toward evaluating the feasibility of using nuclear magnetic resonance (NMR) to measure gas energy content and density. The hydrogen NMR properties of pure hydrocarbon gases, natural gases, and mixtures of gases were measured over wide ranges of temperature and pressure. The data were analyzed to determine the potential and limitations of NMR for determining the calorific value of the gas, the composition, and gas density. Results are very favorable to the practical use of simple NMR apparatus for online measurements of gas energy content, density, and

compressibility factors. References obtained during a literature search are listed.

0340 Combustion

Refer also to citation(s) 33182, 33183, 33184

33201 (PB–89-142624/XAB) **Projects within the Center for Advanced Materials. Annual report, June 1, 1987-May 31, 1988.** Hellmann, J.R.; Kennedy, B.K. Pennsylvania State Univ., University Park, PA (USA). Center for Advanced Materials. Jun 1988. 366p. (CAM–8807). Available from NTIS, PC A16/MF A01.

See also PB–88-123054.

The Gas Research Institute (GRI) has recognized an opportunity for improving gas-fired industrial-utilization technology through the application of advanced high-temperature materials. The GRI-sponsored research projects within the Center for Advanced Materials at the Pennsylvania State University (CAM) were in three major areas: technology assessment and dissemination, analytical and engineering services, and research. CAM's technology and information dissemination efforts are specifically designed to meet the applications and material development needs of advanced-materials suppliers, equipment manufacturers, and industrial end users, who require the timely application of state-of-the-art materials in such applications as waste-heat-recovery systems, advanced gas-fired heating and melting systems, and gas-fired industrial prime movers to ensure the more cost-effective, efficient use of natural gas. The Center's analytical and engineering services are designed to provide GRI's contractors with consulting support and access to Penn State's unique laboratory facilities. The service is designed to provide rapid solutions to applications problems and to conduct short-term research on specific applications issues. Research at CAM the year has identified numerous applications-specific issues for potential advances in the industrial utilization of natural gas. A number of interrelated research projects were initiated to address these issues.

33202 **High pressure autoignition of natural gas/air mixtures and the problem of engine knock.** Westbrook, C.K. (Lawrence Livermore Nat. Lab., Livermore, CA (US)); Pitz, W.J. v.v of The Combustion Institute joint conference: Western states and Japanese sections (Extended Abstracts). Combustion Institute, Pittsburgh, PA (1988). (CONF-871118–: Combustion Institute joint fall meeting: Western states and Japanese sections, Honolulu, Hawaii, USA, 22-25 Nov 1987).

A detailed chemical kinetic reaction mechanism is used in a numerical model to examine the rate of autoignition in mixtures of natural gas and air under conditions which occur in internal combustion engines. The effects of variations in typical engine operating parameters on this autoignition rate are assessed, and the rate of ignition is related to the onset of engine knock.

33203 **Pulsed plasma jet igniters.** Cavolowsky, J.A. (Lawrence Berkeley Lab., Berkeley, CA (US)); Breber, P.R.; Oppenheim, A.K.; Lucas, D. v.v of The Combustion Institute joint conference: Western states and Japanese sections (Extended Abstracts). Combustion Institute, Pittsburgh, PA (1988). (CONF-871118–: Combustion Institute joint fall meeting: Western states and Japanese sections, Honolulu, Hawaii, USA, 22-25 Nov 1987).

The authors have determined the mole fractions of the chemical species present in the plume of a pulsed plasma jet igniter during the ignition and subsequent combustion of methane/oxygen/nitrogen and methane/oxygen/argon mixtures. Equivalence ratios of 1.0, 0.6, and 0.4 were used in the jet cavity and in the main combustion chamber to obtain results for both combusting and non-combusting cases.

33204 **Simplified kinetics for diffusion flames of methane in air.** Bilger, R.W. (Sandia Nat. Labs., Livermore, CA (US)); Kee, R.J. v.v of The Combustion Institute joint conference: Western states and Japanese sections (Extended Abstracts). Combustion Institute, Pittsburgh, PA (1988). (CONF-871118–: Combustion Institute joint fall meeting: Western states and Japanese sections, Honolulu, Hawaii, USA, 22-25 Nov 1987).

A four-step mechanism for the combustion of methane in air in diffusion flames is obtained by making steady state approximations for minor species. The model gives good predictions of flame structure, including steady-state minor species, throughout the flame and gives a good prediction of extinction by flame stretch.

33205 **The influence of pressure disturbances on spontaneous ignition.** Lutz, A.E. (Sandia Nat. Labs., Livermore, CA (US)); Kee, R.J.; Miller, J.A. v.v of The Combustion Institute joint conference: Western states and Japanese sections (Extended Abstracts). Combustion Institute, Pittsburgh, PA (1988). (CONF-871118–: Combustion Institute joint fall meeting: Western states and Japanese sections, Honolulu, Hawaii, USA, 22-25 Nov 1987).

Combustion ignition processes, including engine knock, are problems in which the combination of chemical kinetics and fluid dynamics play important roles. There is little doubt that ignition and knocking depend on chemical kinetics. But how important are gas dynamic disturbances? The strong temperature nonlinearities inherent in chemical kinetics are reason to believe that these disturbances can have a strong influence on ignition. Evidence of this influence comes from asymptotic studies with one-step kinetics. These studies show that the amplitude at which pressure disturbances become important is proportional to the inverse of a dimensionless activation energy. So small amplitude pressure waves may be important when the global activation energy of a fuel is large. In addition, observations of strong and weak ignitions in shock tube experiments lead to believe that there are conditions under which real fuels are sensitive to relatively small disturbances. The purpose of this paper is to determine quantitively the influence of pressure disturbances on the kinetic processes that govern ignition.

33206 **The local structure of turbulent nonpremixed flames of methane near extinction.** Masri, A.R. (Sandia Nat. Labs., Livermore, CA (US)); Bilger, R.W.; Dibble, R.W. v.v of The Combustion Institute joint conference: Western states and Japanese sections (Extended Abstracts). Combustion Institute, Pittsburgh, PA (1988). (CONF-871118–: Combustion Institute joint fall meeting: Western states and Japanese sections, Honolulu, Hawaii, USA, 22-25 Nov 1987).

Various scales and microscales of turbulence in nonpremixed flames of methane close to extinction are calculated from measurements of velocity, turbulence, temperature and species mass fractions. It is found that the local flame structure is largely determined from local mixing conditions, independent of the history effects and the intensity of the mixing rates. Regime diagrams indicate that thin laminar flamelets as well as broad, distributed reaction zones with internal turbulence may be found in these flames.

04 OIL SHALES AND TAR SANDS

0401 Reserves and Exploration

Refer also to citation(s) 34755

0402 Site Geology and Hydrology

Refer also to citation(s) 33213

0403 Drilling, Fracturing, and Mining

33207 (EMR/CRL–88-48) **Survey of microprocessor based performance monitoring devices in Canadian surface coal and oil sands mines in 1987.** Naidu, H.G. Department of Energy, Mines and Resources, Ottawa, ON (Canada). Coal Research Labs. Div. 1988. 20p. (MICROLOG–89-00474). Available from Canada Centre for Mineral and Energy Technology, Technical Information Division, 555 Booth St., Rm. 342, Ottawa, ON, Canada K1A 0G1; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Findings are presented from an industry survey carried out to determine the current status of microprocessor based devices used for monitoring surface mining equipment. There seems to be a general awareness in the industry towards the usefulness of this emerging technology. Some of the larger coal and oilsands mining operations have installed these devices on larger equipment. However, except

for a handful of older units, many devices are still going through a process of field evaluation. At present, microprocessor devices are being used on draglines, bucketwheels and belt conveyors to provide information on equipment performance parameters. Recent developments include installations on blasthole drills, shovels and off-highway trucks. During the past year, second generation, more sophisticated monitors have been provided on draglines. Such devices are becoming an integral part of the equipment and are now included as a standard component in equipment specifications. 6 refs., 3 figs.

0404 Oil Production, Recovery, and Refining

Refer also to citation(s) 33043, 33158, 33159, 35503

33208 (CONF-880589–, pp. 271-278) **Study on pyrolysis of particulate oil shale with an improved thermogravimetric apparatus.** Wang, J. (Beijing United Research Institute of Applied Chemistry and Chemical Engineering (China)); Li, S.; Yang, K. Colorado School of Mines, Golden, CO (USA). 1988. From International conference on oil shale and shale oil; Beijing, China; 16-19 May 1988. In *International conference on oil shale and shale oil; Proceedings.* Order Number DE89010445/JAW. Available from NTIS, PC A 99; 3.

In the usual study on the pyrolysis of particulate oil shale weight loss and temperature measurements are made separately. In the present work a China-made LCT-1 thermogravimetric apparatus was modified to measure the center temperature and surface temperature of sample particle simultaneously with weight loss measurement. Cylindrical particles of Fushun and Maoming oil shales of 2-10 mm equal height diameter were used. Weight loss measurements and temperature histories enabled the investigation of the influence of particle size and heating temperature on pyrolysis time in an accurate and convenient way. At a constant heat-up rate of 5°C/min, for a shale cylinder of 10 mm diameter, the center temperature was slightly lower than the surface temperature, and the difference in temperature for Fushun oil shale was only 2°C, while for Maoming oil shale it was 4°C. An overall first order reaction model was used to describe the pyrolysis process of particulate oil shale. For Fushun oil shale the retorting time required was proportional to the diameter squared, while for Maoming oil shale it was proportional to the particle diameter. This difference could be accounted for by more developed lamination of the latter. The results obtained could be used for reference for design and production of particulate oil shale retorting.

33209 (CONF-880589–, pp. 392-399) **Development of oil shale retorting plant in Japan. Part I. Construction of the pilot plant.** Yabushita, T. (Japan Oil Shale Engineering Co., Ltd., Tokyo). Colorado School of Mines, Golden, CO (USA). 1988. From International conference on oil shale and shale oil; Beijing, China; 16-19 May 1988. In *International conference on oil shale and shale oil; Proceedings.* Order Number DE89010445/JAW. Available from NTIS, PC A 99; 3.

On consignment from the Ministry of International Trade and Industry (MITI) and the Japan National Oil Corporation (JNOC), Japan Oil Shale Engineering Co., Ltd. (JOSECO) constructed an oil shale pilot plant. In this pilot plant, a shaft type retort was selected as the retorting and gasifying unit. Fixed-bed type drying facilities were installed to examine the economics of pre-drying oil shale with a high water content. Fluidized-bed combustion facilities were juxtaposed to study the efficient combustion of oil shale.

33210 (CONF-880589–, pp. 415-423) **Oil shale retorting technology in Maoming.** Lin, Y. (Maoming Petroleum Industrial Corp. (China)). Colorado School of Mines, Golden, CO (USA). 1988. From International conference on oil shale and shale oil; Beijing, China; 16-19 May 1988. In *International conference on oil shale and shale oil; Proceedings.* Order Number DE89010445/JAW. Available from NTIS, PC A 99; 3.

Two batteries of 48 gas combustion rectangular retorts and two batteries of 64 cylindrical retorts, were established in the sixties for processing Maoming oil shale with high moisture and low Fischer assay. Rich operation experiences have been accumulated. Study on improvement of retorting technologies is under way. The Maoming rectangular and cylindrical retorts are characterized by simple structure, capability of processing oil shale with high moisture (20%), low Fischer assay (4-6%), and low organic carbon (4-8%) in shale char while maintaining heat self-sufficiency. These two types of retorts have been operated for more than 20 years. They are easy to operate in a long period. The burning of shale oil in the gasification section remains to be solved.

33211 (DOE/MC/22134–2698) **Fluidized bed retorting of eastern oil shale.** Gaire, R.J.; Mazzella, G. Foster Wheeler USA Corp., Clinton, NJ (USA). Mar 1989. 347p. Sponsored by DOE Fossil Energy. DOE Contract AC21-86MC22134. Order Number DE89000976/JAW. Available from NTIS, PC A15/MF A01 - OSTI.

This topical report summarizes the conceptual design of an integrated oil shale processing plant based on fluidized bed retorting of eastern New Albany oil shale. This is the fourth design study conducted by Foster Wheeler; previous design cases employed the following technologies: Fluidized bed rotating/combustion of Colorado Mahogany zone shale. An FCC concept of fluidized bed retorting/combustion of Colorado Mahogany zone shale. Directly heated moving vertical-bed process using Colorado Mahogany zone shale. The conceptual design encompasses a grassroots facility which processes run-of-mine oil shale into a syncrude oil product and dispose of the spent shale solids. The plant has a nominal capacity of 50,000 barrels per day of syncrude product, produced from oil shale feed having a Fischer Assay of 15 gallons per ton. Design of the processing units was based on non-confidential published information and supplemental data from process licensors. Maximum use of process and cost information developed in the previous Foster Wheeler studies was employed. The integrated plant design is described in terms of the individual process units and plant support systems. The estimated total plant investment is detailed by plant section and estimates of the annual operating requirements and costs are provided. In addition, process design assumptions and uncertainties are documented and recommendations for process alternatives, which could improve the overall plant economics, are discussed. 12 refs., 17 figs., 52 tabs.

33212 (WU/WCP–50/204) **Biotechnological methods for upgrading of bitumen, heavy oil, and residue. Final report for phase 2.** Ching, G.; Rioux, S.; Scharer, J.M.; Moo-Young, M. Waterloo Univ., ON (Canada). Waterloo Centre for Process Development. [1989]. 142p. (MICROLOG–89-01742). Available from Canada Centre for Mineral and Energy Technology, Technical Information Division, 555 Booth St., Rm. 342, Ottawa, ON, Canada K1A 0G1; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Research was conducted on establishing the most suitable organisms and growth conditions for microbially upgrading Lloydminster crude. A series of comparative experiments were performed, using a variety of bacterial species and growth conditions for both Lloydminster crude and a synthetic analogue. These early experiments indicated a superiority of one organism, Arthrobacter paraffineus, in viscosity and interfacial surface tension reduction and for sulfur removal. Optimum growth conditions and medium compositions were determined. In a series of studies aimed at optimizing the performance of Arthrobacter paraffineus in a continuously stirred tank reactor, various combinations of media, aeration, and growth conditions were investigated using Lloydminster crude as a substrate. It was found that 12% of the organic sulfur could be removed during a six-day incubation period under aerobic conditions. Sulfur removal was dependent on growth conditions. Comparative studies under anaerobic conditions were performed with Desulfovibrio desulfuricans. Anoxic conditions were maintained by sparging the continuous stirred reactor with nitrogen. The sulfur removal ranged from 10.7% in synthetic media to 0.17% sulfur from crude oil. The low sulfur removal from crude oil was attributed to growth-inhibitory compounds in the crude. These preliminary results indicate that limited sulfur removal from crude oil is possible using monocultures of Arthrobacter paraffineus or Desulfovibrio desulfuricans. A concurrent beneficial effect is a reduction of viscosity (by biosurfactants) and surface tension obtainable under these conditions. 8 refs., 23 figs., 14 tabs.

33213 **In-situ stresses in low-permeability, nonmarine rocks.** Warpinski, N.R. (Sandia National Labs. (US)); Teufel, L.W. *Journal of Petroleum Technology (USA)*, 41(4): 405-414 (Apr 1989).

In-situ stress measurements have been performed over a 2,500-ft [760-m] interval in the nonmarine section of the Cretaceous Mesaverde in the Piceance basin in Colorado. These measurements included 52 hydraulic fracture measurements of the minimum in-situ stress and 22 anelastic strain recovery (ASR) measurements. Stress data obtained in sandstones, shales, mudstones, siltstones, and coals show the effect of lithology on the magnitudes of the stresses.

0405 Properties and Composition

Refer also to citation(s) 33118, 33213, 34047, 35503

33214 (ACERR–1989, pp. 6) **E.S.R. measurements on asphaltene and resin fractions from various separation methods.** Schultz, K.F. (Alberta Research Council, Edmonton, AB, Canada); Selucky, M.C. Alberta/Canada Energy Resources Research Fund, Edmonton, AB (Canada). [1989]. (CE–02653). In *Alberta Research Council [research reports].* Available from Alberta Energy and Natural Resources, Information Centre, 9920-108 St., Edmonton, AB, Canada T5K 2M4; $N/C.

Asphaltenes and resins obtained from Athabasca and Cold Lake bitumens have been fractionated by adsorption, ion-exchange, and gel permeation chromatography (gpc). These fractions have been investigated by electron spin resonance of their organic paramagnetic components and vanadium (IV) content. The correlation between number of spins, vanadium content and fractions sequence is discussed. The study showed that in very dilute solutions, the gel permetion chromatograms of asphaltenes were changing with time, shifting progressively towards lower molecular weights and that the same type of changes could be observed in gpc of asphaltene fractions from ion-exchange chromatography at various time intervals. Considerable overlaps existed between asphaltene and resin fractions obtained under identical conditions upon adsorption, ion-exchange and gel permeation chromatography of these two bitumen components. The separation of asphaltenes by precipitation is a process depending both on fraction solubility and polarity. 20 refs., 5 figs., 4 tabs.

33215 (ACERR–1989, pp. 19) **Structure-related properties of Athabasca asphaltenes and resins as indicated by chromatographic separation.** Selucky, M.L. (Alberta Research Council, Edmonton, AB, Canada); Kim, S.S.; Skinner, F.; Strausz, O.P. Alberta/Canada Energy Resources Research Fund, Edmonton, AB (Canada). [1989]. (CE–02653). In *Alberta Research Council [research reports].* Available from Alberta Energy and Natural Resources, Information Centre, 9920-108 St., Edmonton, AB, Canada T5K 2M4; $N/C.

Asphaltenes and resins from Athabasca bitumen were further separated by adsorption, ion exchange, and gel permeation chromatography (GPC). Molecular weights of asphaltene fractions from silica gel decreased with increasing fraction polarity while in ion exchange chromatography the highest molecular weight fractions were most strongly retained. In all three systems studied there is a considerable overlap in behavior of the resins and asphaltenes, showing that resins and asphaltenes are part of a continuum of structures, and confirming that solubility separations give complex aggregates where composition may vary with the precipitation conditions. Changes in solubility of fractions separated from these materials suggest that upon solvent evaporation new types of agglomerates are forming after removal of some mixture components. GPC of very dilute solutions of asphaltenes and their fractions clearly confirm the above implications and demonstrate that these materials represent a dynamic time-dependent system that changes tomodular-weight entities of the size of polyaromatic hydrocarbons and similar materials. It was concluded that definition of asphaltenes based only on solubility is not a satisfactory criterion and that the behavior of asphaltenes in chromatographic separations is incompatible with such structures where the polymer units are interconnected predominantly by σ-bonds. 28 refs., 15 figs., 6 tabs.

33216 (ACERR–1989, pp. 23) **Separation of asphaltenes and resins as a criterion for the future of class analysis of fossil fuels.** Selucky, M.L. (Alberta Research Council, Edmonton, AB, Canada). Alberta/Canada Energy Resources Research Fund, Edmonton, AB (Canada). [1989]. (CE–02653). In *Alberta Research Council [research reports].* Available from Alberta Energy and Natural Resources, Information Centre, 9920-108 St., Edmonton, AB, Canada T5K 2M4; $N/C.

This report studies the behaviour of asphaltenes and resins in various systems based on chromatography, extraction and relative solubilities. Resins and asphaltenes are part of a continuum of progressively larger structures and the present classification is the main stumbling block to the introduction of fast analytical methods for class analysis of bitumen components and other, similar materials. The results of the experiments strongly suggest that formulations of large polymeric sheets of asphaltenes might be in error and that the micelle structure of aggregates of progressively increasing degree of aggregation is much more probable. It can be concluded that evidence brought by chromatographic separations of resins and asphaltenes shows that asphaltenes and resins are parts of a continuum of structures and confirm that definitions based on solubility are a very poor representation of the underlying chemical and physical phenomena. Changes in solubility of fractions once they are separated from the bulk material together with gel permeation chromatography experiments on a very dilute solutions show that new types of agglomerates are forming after any separation into fractions. 11 refs., 4 figs., 1 tab.

33217 (ARC–1989, pp. 4) **Identification of nitrogen functional groups in Athabasca bitumen.** Moschopedis, S.E. (Alberta Research Council, Edmonton); Hawkins, R.W.; Speight, J.G. Alberta Research Council, Edmonton, AB (Canada). [1989]. (CE–02438). In *Alberta Research Council [research reports].* Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages.

Reactions of resins, asphaltenes and model nitrogen compounds with acetic anhydride and with trifluoroacetic anhydride yield compounds which provide indications that the predominant nitrogen functional groups in resins and asphaltenes (from Athabasca bitumen) exist as imino groups of the carbazole-type. Evidence for this was obtained from infrared and 19F nuclear magnetic resonance studies. 22 refs., 2 figs., 1 tab.

0409 Waste Research and Management

Refer also to citation(s) 33211

05 NUCLEAR FUELS

0501 Reserves, Exploration, and Mining

Refer also to citation(s) 33218, 33222, 33223, 33224, 33225, 34057, 34759

0504 Feed Processing

Refer also to citation(s) 33326, 33327

33218 (IAEA-TECDOC–492) **In situ leaching of uranium: Technical, environmental and economic aspects. Proceedings of a technical committee meeting held in Vienna, 3-6 November 1987.** International Atomic Energy Agency, Vienna (Austria). Jan 1989. 172p. (CONF-8711306–: Technical committee meeting on in situ leaching of uranium: Technical, environmental and economic aspects, Vienna, Austria, 3-6 Nov 1987). Order Number DE89617917/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

Within the framework of its activities in nuclear raw materials the International Atomic Energy Agency has convened a series of meetings to discuss various aspects of uranium ore processing technology, recovery of uranium from non-conventional resources

and development of projects for the production of uranium concentrates including economic aspects. As part of this continuing effort to discuss and document important aspects of uranium production the IAEA convened a Technical Committee Meeting on Technical, Economic and Environmental Aspects of In-Situ Leaching. Although the use of this technique is limited by geological and economic constraints, it has a significant potential to produce uranium at competitive prices. This is especially important in the current uranium market which is mainly characterised by large inventories, excess production capability and low prices. This situation is not expected to last indefinitely but it is unlikely to change drastically in the next ten years or so. This Technical Committee Meeting was held in Vienna from 3 to 6 November 1987 with the attendance of 24 participants from 12 countries. Eight papers were presented. Technical sessions covered in-situ mining research, environmental and licensing aspects and restoration of leached orebodies; the technological status of in-situ leaching, the current status and future prospects of in-situ leaching of uranium in Member States, general aspects of planning and implementation of in-situ projects and the economics of in-situ leaching. Refs, figs and tabs.

33219 (IAEA-TECDOC–492, pp. 7-20) **Introduction to in situ leaching of uranium.** Rojas, J.L. (International Atomic Energy Agency, Vienna (Austria). Div. of Nuclear Fuel Cycle). International Atomic Energy Agency, Vienna (Austria). Jan 1989. (CONF-8711306–: Technical committee meeting on in situ leaching of uranium: Technical, environmental and economic aspects, Vienna, Austria, 3-6 Nov 1987). In *In situ leaching of uranium: Technical, environmental and economic aspects. Proceedings of a technical committee meeting held in Vienna, 3-6 November 1987.* Order Number DE89617917/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

As an introduction to the several discussions on in-situ leaching, the main concepts of this technology are reviewed in order to clarify some important ideas such as: geological constraints, hydrology, aquifer restoration, environmental impacts and future trends.

33220 (IAEA-TECDOC–492, pp. 37-62) **Uranium in situ mining research by the United States Bureau of Mines - A review.** Pugliese, J.M. (Department of the Interior, Minneapolis, MN (USA). Bureau of Mines); Larson, W.C. International Atomic Energy Agency, Vienna (Austria). Jan 1989. (CONF-8711306–: Technical committee meeting on in situ leaching of uranium: Technical, environmental and economic aspects, Vienna, Austria, 3-6 Nov 1987). In *In situ leaching of uranium: Technical, environmental and economic aspects. Proceedings of a technical committee meeting held in Vienna, 3-6 November 1987.* Order Number DE89617917/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

The Bureau of Mines initiated its in situ mining research program in 1974 to advance in situ mining as a viable alternative to conventional open pit and underground mining methods. At first, research work was conducted in two principal areas–fluid flow modeling, and geochemical modeling to represent leaching reactions in the ore body. Subsequently, the work effort evolved into a multiphase in situ mining research program designed to find a more economical way of mining while minimizing negative impacts on the environment. This paper discusses aspects of the Bureau's laboratory and field research accomplishments on the following topics: (1) permeability of uranium-bearing sandstone, (2) environment and restoration of ground water, (3) fluid flow and geochemical modeling, (4) environmentally attractive leach solutions, (5) well construction and completion, and (6) cost and sensitivity analysis for uranium in situ mining. Additional details about the research accomplishments are discussed in the Bureau publications and patents shown for each of these topics. Information is also provided on how to obtain copies of these Bureau references. (author). 47 refs, 11 figs.

33221 (IAEA-TECDOC–492, pp. 63-74) **Restoration of in situ leached uranium ores: A laboratory study of restoration reagents.** Grant, D.C. (Department of the Interior, Salt Lake City, UT (USA). Bureau of Mines); Burgman, H.A.; Seidel, D.C. International Atomic Energy Agency, Vienna (Austria). Jan 1989. (CONF-8711306–: Technical committee meeting on in situ leaching of uranium: Technical, environmental and economic aspects, Vienna, Austria, 3-6 Nov 1987). In *In situ leaching of uranium: Technical, environmental and economic aspects. Proceedings of a technical committee meeting held in Vienna, 3-6 November 1987.* Order Number DE89617917/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

Ammonium bicarbonate has been used as the primary lixiviant in many in situ uranium mining operations. During the leaching operation, ammonium ions exchange with the cations of the ores clay fraction and, after mining is complete, may desorb into the ground water along with other elements. Laboratory column tests were used to evaluate the effect of various restoration reagents on the leakage levels of ammonium, uranium, and selenium ions. Aluminium chloride significantly reduced leakage levels and also increased ore bed permeability. (author). 3 refs, 7 figs, 4 tabs.

33222 (IAEA-TECDOC–492, pp. 75-96) **Adapting uranium in situ mining technology for new commercial operations.** Montgomery, A.H. (Canonie Environmental Services Corp., Englewood, CO (USA)). International Atomic Energy Agency, Vienna (Austria). Jan 1989. (CONF-8711306–: Technical committee meeting on in situ leaching of uranium: Technical, environmental and economic aspects, Vienna, Austria, 3-6 Nov 1987). In *In situ leaching of uranium: Technical, environmental and economic aspects. Proceedings of a technical committee meeting held in Vienna, 3-6 November 1987.* Order Number DE89617917/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

The vast majority of uranium produced commercially in the United States by in-situ leach methods has come from the South Texas deposits. The technology is applicable to deposits in other parts of the United States with some modifications. This paper reviews the technology variations and operating procedures used to mine other deposits and compares these with South Texas operations. Suggestions are made as to how improvements in technology and operating procedures will make uranium in-situ mining operations more competitive in today's market. (author). 12 figs, 8 tabs.

33223 (IAEA-TECDOC–492, pp. 127-142) **In situ leaching of Yozgat-Sorgun-Temrezli uranium deposit - Related laboratory experiments.** Oner, G. (Istanbul Technical Univ. (Turkey). Dept. of Chemical Engineering); Nasun, G.; Cataltas, A.I.; Okutan, H. International Atomic Energy Agency, Vienna (Austria). Jan 1989. (CONF-8711306–: Technical committee meeting on in situ leaching of uranium: Technical, environmental and economic aspects, Vienna, Austria, 3-6 Nov 1987). In *In situ leaching of uranium: Technical, environmental and economic aspects. Proceedings of a technical committee meeting held in Vienna, 3-6 November 1987.* Order Number DE89617917/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

The main objective of this study was to investigate the leaching performance of Yozgat-Sorgun-Temrezli uranium ore under in-situ leaching conditions in the laboratory. For this purpose first XRD and various chemical analyses were performed; and, batch, autaclave and column pack leach tests were carried out with several acid and alkaline systems. The systems used as lixiviant were HNO_3, H_2SO_4-H_2O_2, H_2SO_4-MnO_2, Na_2CO_3-$NaHCO_3$ H_2O_2, K_2CO_3-$KHCO_3$-H_2O_2 and $(NH_4)_2CO_3$-NH_4HCO_3-H_2O_2. Although XRD examinations showed that the main minerals were SiO_2, Al_2O_3 and $CaCO_3$, no specific uranium mineral was detected on the blended uranium ore sample. Batch and autaclave leach tests indicate that 0.1M H_2SO_4-0.3g/1 H_2O_2 is the most desirable leachate for extracting this ore. Column pack leach tests confirmed that U_3O_8 could be leached rapidly and to high recoveries (95%) using sulfuric acid-peroxide solution. Sodium carbonate was found to be the most effective alkaline system. Batch leach tests indicated that the optimum carbonate and bicarbonate concentrations were 0.085 M and 0.015 M respectively and the addition of hydrogen peroxide to the extraction solution always increased the yield of uranium. Fifty seven percent recovery was obtained with 0.085 M Na_2CO_3-0.015 M $NaHCO_3$-2g/1 H_2O_2 lixiviant. Similar results observed during alkaline column leach test. Preliminary laboratory leaching tests proved the applicability of in situ uranium leaching process for Yozgat-Sorgun-Temrezli uranium deposit. 6 refs, 6 figs, 10 tabs.

33224 (IAEA-TECDOC–492, pp. 143-152) **In situ leaching of uranium in the USSR.** Skorovarov, J.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR)); Sadykov, R.H.; Nosov, V.D. International Atomic Energy Agency, Vienna (Austria). Jan 1989. (CONF-8711306–: Technical committee

meeting on in situ leaching of uranium: Technical, environmental and economic aspects, Vienna, Austria, 3-6 Nov 1987). In *In situ leaching of uranium: Technical, environmental and economic aspects. Proceedings of a technical committee meeting held in Vienna, 3-6 November 1987.* Order Number DE89617917/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

The paper describes the utilization of in-situ technology for exploitation of some uranium ores in the USSR. The geological requirements of the orebody and the ore content in uranium are described. The characteristics of well fields and the form of doing the leaching are described considering the advantages and inconvenience of acid and bi-carbonate methods of leaching. In order to decide the method of uranium mining an index is defined considering the difference between commercial reserves and uranium extracted. (author). 6 refs.

33225 (IAEA-TECDOC–492, pp. 153-158) **Potentialities of percolation leaching of uraniferous siltstone from Wadi-Nasib, Egypt.** Mahdy, M.A. (Nuclear Materials Corp., Cairo (Egypt)). International Atomic Energy Agency, Vienna (Austria). Jan 1989. (CONF-8711306–: Technical committee meeting on in situ leaching of uranium: Technical, environmental and economic aspects, Vienna, Austria, 3-6 Nov 1987). In *In situ leaching of uranium: Technical, environmental and economic aspects. Proceedings of a technical committee meeting held in Vienna, 3-6 November 1987.* Order Number DE89617917/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

An uraniferous sedimentary formation has lately been discovered in Wadi Nasib area, west central Sinai, Egypt. The formation belongs to the lower Carboniferous, and involves various facies namely: siltstone, shale, sandstone and gravel. Mineralogically the siltstone facies is composed of kaolinite 60%, montmorillonite 10%, quartz 15% and iron oxides range from 10-15%, while the economic minerals are represented mainly by atacamite Cu_2 Cl OH_3 and K-rich zippeite $2UO_3.SO_3.5H_2O$. and meta-autonite Ca $(UO_2)_2$ $(PO_4)_2.8H_2O$. A series of agitation leaching experiments were performed on a laboratory scale using different mineral acids and the obtained results indicated almost complete leaching of both uranium and copper. However, by alkaline leaching using sodium carbonate and/or sodium bicarbonate, it was possible to dissolve uranium almost selectively leaving copper in an insoluble form. Indeed, the low grade nature of the ore material and its amenability to leaching under mild conditions inferred the application of in-situ leaching. The latter is largely preferable due to various environmental, economical and technical aspects. Therefore, a number of percolation leaching experiments using water as well as acid and alkaline solutions were performed to study the different relevant factors. Preliminary data indicated encouraging results and the various achieved laboratory tests would be used to plan for a pilot plant study. (author). 9 refs, 11 figs, 1 tab.

0507 Fuels Production and Properties

Refer also to citation(s) 33814, 33956, 34063, 35098, 35099, 35100, 35101, 35102, 35104, 35105, 35106, 35107, 35108, 35109, 35126

33226 (BARC–1421) **Advanced methods for fabrication of PHWR and LMFBR fuels.** Ganguly, C. Bhabha Atomic Research Centre, Bombay (India). 1988. 31p. Order Number DE89614470/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

For self-reliance in nuclear power, the Department of Atomic Energy (DAE), India is pursuing two specific reactor systems, namely the pressurised heavy water reactors (PHWR) and the liquid metal cooled fast breeder reactors (LMFBR). The reference fuel for PHWR is zircaloy-4 clad high density ($\leq$ 96 per cent T.D.) natural UO_2 pellet-pins. The advanced PHWR fuels are UO_2-PuO_2 ($\leq$ 2 per cent), ThO_2-PuO_2 ($\leq$ 4 per cent) and ThO_2-$U^{233}O_2$ ($\leq$ 2 per cent). Similarly, low density ($\leq$ 85 per cent T.D.) $(UPu)O_2$ pellets clad in SS 316 or D9 is the reference fuel for the first generation of prototype and commercial LMFBRs all over the world. However, (UPu)C and (UPu)N are considered as advanced fuels for LMFBRs mainly because of their shorter doubling time. The conventional method of fabrication of both high and low density oxide, carbide and nitride fuel pellets starting from UO_2, PuO_2 and ThO_2 powders is 'powder metallurgy (P/M)'. The P/M route has, however, the disadvantage of generation and handling of fine powder particles of the fuel and the associated problem of 'radiotoxic dust hazard'. The present paper summarises the state-of-the-art of advanced methods of fabrication of oxide, carbide and nitride fuels and highlights the author's experience on sol-gel-microsphere-pelletisation (SGMP) route for preparation of these materials. The SGMP process uses sol gel derived, dust-free and free-flowing microspheres of oxides, carbide or nitride for direct pelletisation and sintering. Fuel pellets of both low and high density, excellent microhomogeneity and controlled 'open' or 'closed' porosity could be fabricated via the SGMP route. (author). 5 tables, 14 figs., 15 refs.

0508 Spent Fuels Reprocessing

Refer also to citation(s) 33234, 33237, 33238, 33241, 33242, 33244, 33313, 33333, 33917

33227 Design concepts and advanced telerobotics development for facilities in the back end of the nuclear fuel cycle. Feldman, M.J. (Oak Ridge National Lab., TN (USA)). *Transactions of the American Nuclear Society (USA),* 56(1): 545-551 (1988). (CONF-870905–: 6. Pacific Basin nuclear conference, Beijing, China, 7-11 Sep 1987).

In the Fuel Recycle Division at the Oak Ridge National Laboratory (ORNL), a comprehensive remote systems development program has existed for the past seven years. The new remote technology under development is expected to significantly improve remote operations by extending the range of tasks accomplished by remote means and increasing the efficiency of remote work undertaken. Five areas of the development effort are primary contributors to the goal of higher operating efficiency for major facilities for the back end of the nuclear fuel cycle. These areas are: (1) the single-cell concept, (2) the low-flow ventilation concept, (3) television viewing, (4) equipment-mounting racks, and (5) force-reflecting manipulation. These somewhat innovative directions are products of a design process where the technical scenario to be accomplished, the remote equipment to accomplish the scenario, and the facility design to house the equipment, are considered in an interactive design process to optimize performance, maximize long-term costs effectiveness, and minimize initial capital outlay.

0509 Transport and Storage

Refer also to citation(s) 33298

33228 (BMI/OTSP–04) **Analysis of human factors effects on the safety of transporting radioactive waste materials: Technical report.** Abkowitz, M.D.; Abkowitz, S.B.; Lepofsky, M. Battelle Memorial Inst., Columbus, OH (USA). Office of Transportation Systems and Planning. Apr 1989. 98p. Sponsored by DOE Radioactive Waste Management. DOE Contract AC02-83CH10139. Order Number DE89013120/JAW. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

This report examines the extent of human factors effects on the safety of transporting radioactive waste materials. It is seen principally as a scoping effort, to establish whether there is a need for DOE to undertake a more formal approach to studying human factors in radioactive waste transport, and if so, logical directions for that program to follow. Human factors effects are evaluated on driving and loading/transfer operations only. Particular emphasis is placed on the driving function, examining the relationship between human error and safety as it relates to the impairment of driver performance. Although multi-modal in focus, the widespread availability of data and previous literature on truck operations resulted in a primary study focus on the trucking mode from the standpoint of policy development. In addition to the analysis of human factors accident statistics, the report provides relevant background material on several policies that have been instituted or are under consideration, directed at improving human reliability in the transport sector. On the basis of reported findings, preliminary policy areas are identified. 71 refs., 26 figs., 5 tabs.

33229 (BMI/OTSP–06) **Study of minimum-weight highway transporters for spent nuclear fuel casks: Technical report.**

Hoess, J.A.; Drago, V.J. Battelle Memorial Inst., Columbus, OH (USA). Office of Transportation Systems and Planning. May 1989. 46p. Sponsored by DOE Radioactive Waste Management. DOE Contract AC02-83CH10139. Order Number DE89013119/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

There are federal and state limits on the maximum tractor-trailer-payload combination and individual axle loads permissible on US highways. These can generally be considered as two sets, i.e., legal-weight and overweight limits. The number of individual shipments required will decrease as the capacity of the spent nuclear fuel cask increases. Thus, there is an incentive for identifying readily available minimum-weight tractors and trailers capable of safely and reliably transporting as large a cask as possible without exceeding the legal gross combination weight (GCW) of 80,000 lb or selected overweight GCW limit of 110,000 lb. This study identifies options for commercially available heavy-duty on-highway tractors and trailers for transporting proposed future loaded spent nuclear fuel casks. Loaded cask weights of 56,000 and 80,000 lb were selected as reference design points for the legal-weight and overweight transporters, respectively. The technical data on tractor and trailer characteristics obtained indicate that it is possible to develop a tractor-trailer combination, tailored for spent nuclear fuel transportation service, utilizing existing technology and commercially available components, capable of safely and reliably transporting 56,000 and 80,000-lb spent nuclear fuel casks without exceeding GCWs of 80,000 and 10,000 lb, respectively. 4 figs., 14 tabs.

33230 (CONF-890631–45) **A fuel response model for the design of spent fuel shipping casks.** Malinauskas, A.P.; Duffey, T.A.; Einziger, R.E.; Hobbins, R.R.; Jordon, H.; Rashid, Y.R.; Barrett, P.R.; Sanders, T.L. Sandia National Labs., Albuquerque, NM (USA); Oak Ridge National Lab., TN (USA); Battelle Pacific Northwest Lab., Richland, WA (USA); EG and G Idaho, Inc., Idaho Falls, ID (USA). 1989. 11p. Sponsored by DOE Radioactive Waste Management. DOE Contract AC04-76DP00789;AC05-84OR21400;AC06-76RL01830;AC07- From International symposium on packaging and transporting of radioactive materials; Washington, D.C., USA; 11-16 Jun 1989. Order Number DE89013544/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The radiological source terms pertinent to spent fuel shipping cask safety assessments are of three distinct origins. One of these concerns residual contamination within the cask due to handling operations and previous shipments. A second is associated with debris ("crud") that had been deposited on the fuel rods in the course of reactor operation, and a third involves the radioactive material contained within the rods. Although the lattermost source of radiotoxic material overwhelms the others in terms of inventory, its release into the shipping cask, and thence into the biosphere, requires the breach of an additional release barrier, viz., the fuel rod cladding. Hence, except for the special case involving the transport of fuel rods containing previously breached claddings, considerations of the source terms due to material contained in the fuel rods are complicated by the need to address the likelihood of fuel cladding failure during transport. The purpose of this report is to describe a methodology for estimating the shipping cask source terms contribution due to radioactive material contained within the spent fuel rods. Thus, the probability of fuel cladding failure as well as radioactivity release is addressed. 8 refs., 2 tabs.

33231 (CONF-890631–49) **SCALE-4 [Standardized Computer Analyses for Licensing Evaluation]: An improved computational system for spent-fuel cask analysis.** Parks, C.V. Oak Ridge National Lab., TN (USA). 1989. 9p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC05-84OR21400. From International symposium on packaging and transporting of radioactive materials; Washington, D.C., USA; 11-16 Jun 1989. Order Number DE89013535/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The purpose of this paper is to provide specific information regarding improvements available with Version 4.0 of the SCALE system and discuss the future of SCALE within the current computing and regulatory environment. The emphasis focuses on the improvements in SCALE-4 over that available in SCALE-3. 10 refs., 1 fig., 1 tab.

33232 (IAEA-TECDOC–487) **Spent fuel management: Current status and prospects. Proceedings of an advisory group meeting held in Vienna, 15-18 March 1988.** International Atomic Energy Agency, Vienna (Austria). Dec 1988. 164p. (CONF-8803217–: Advisory group meeting on spent fuel management: Current status and prospects, Vienna, Austria, 15-18 Mar 1988). Order Number DE89618148/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

The main objective of the Advisory Group on Spent Fuel Management is to review the world-wide situation in Spent Fuel Management, to define the most important directions of national efforts and international cooperation in this area, to exchange information on the present status and progress in performing the back-end of Nuclear Fuel Cycle and to elaborate the general recommendations for future Agency programmes in the field of spent fuel management. This report which is a result of the third IAEA Advisory Group Meeting (the first and second were held in 1984 and 1986) is intended to provide the reader with an overview of the status of spent fuel management programmes in a number of leading countries, with a description of the past and present IAEA activities in this field of Nuclear Fuel Cycle and with the Agency's plans for the next years, based on the proposals and recommendations of Member States. A separate abstract was prepared for each of 14 papers presented at the advisory group meeting. Refs, figs and tabs.

33233 (IAEA-TECDOC–487, pp. 7-13) **IAEA spent fuel management programme - Past and present.** Sokolov, F. (International Atomic Energy Agency, Vienna (Austria). Div. of Nuclear Fuel Cycle). International Atomic Energy Agency, Vienna (Austria). Dec 1988. (CONF-8803217–: Advisory group meeting on spent fuel management: Current status and prospects, Vienna, Austria, 15-18 Mar 1988). In *Spent fuel management: Current status and prospects. Proceedings of an advisory group meeting held in Vienna, 15-18 March 1988.* Order Number DE89618148/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

The Agency's programme continued to cover developments at all stages of the nuclear fuel cycle. Spent fuel management is one of the most important parts of the nuclear fuel cycle and it is a vital and common problem for all countries developing nuclear power. The Agency's role in this area is to provide a forum for exchanging information on spent fuel management, including technical, environmental, economical and safety aspects of transport, storage and reprocessing of spent fuel, and to encourage closer co-operation among Member States in certain research and development activities that are of common interest. An increased emphasis was placed on nuclear safety, economics, development concepts for fuel storage etc., and on the integrated or multidisciplinary rather than single technique approached. The Agency's activities were performed in the field of spent fuel management are reviewed in this paper.

33234 (IAEA-TECDOC–487, pp. 37-45) **Spent fuel management in Argentina.** Araoz, C. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)); Olezza, R.; Devcic, N.; Adelfang, P. International Atomic Energy Agency, Vienna (Austria). Dec 1988. (CONF-8803217–: Advisory group meeting on spent fuel management: Current status and prospects, Vienna, Austria, 15-18 Mar 1988). In *Spent fuel management: Current status and prospects. Proceedings of an advisory group meeting held in Vienna, 15-18 March 1988.* Order Number DE89618148/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

The general program on Argentinian Spent Fuel Management has been presented in the previous meeting. This presentation includes an updating of the programs and a short description of the mixed oxide rods pilot plant. (author). 1 fig., 5 photographs.

33235 (IAEA-TECDOC–487, pp. 47-57) **Spent fuel management in Canada.** McEachran, R.A. (Ontario Hydro, Toronto, ON (Canada)). International Atomic Energy Agency, Vienna (Austria). Dec 1988. (CONF-8803217–: Advisory group meeting on spent fuel management: Current status and prospects, Vienna, Austria, 15-18 Mar 1988). In *Spent fuel management: Current status and prospects. Proceedings of an advisory group meeting held in Vienna, 15-18 March 1988.* Order Number DE89618148/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

The current status of storage, transport and disposal/recycle of spent fuel is described. Virtually all of the spent fuel is now stored at

the reactor, mostly in water pools, but also in concrete containers. Future plans are for the development of a transportation prototype and for the development of a disposal concept based on deep underground implacement in crystalline rock. (author). 5 figs, 2 tabs.

33236 (IAEA-TECDOC–487, pp. 59-71) **Spent fuel management in Czechoslovak WWER-440 type reactors.** Petenyi, V. (Nuclear Power Plants Research Inst., Trnava (Czechoslovakia)); Polak, V.; Vandlikova, M.; Kmosena, J.; Belko, D. International Atomic Energy Agency, Vienna (Austria). Dec 1988. (CONF-8803217–: Advisory group meeting on spent fuel management: Current status and prospects, Vienna, Austria, 15-18 Mar 1988). In *Spent fuel management: Current status and prospects. Proceedings of an advisory group meeting held in Vienna, 15-18 March 1988.* Order Number DE89618148/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

The main aspects of the present WWER-440 reactors spent fuel management are described in the paper. Experimental results of fuel integrity studies which are carried out under conditions of a long-term storage are also presented. (author). 5 refs, 5 figs.

33237 (IAEA-TECDOC–487, pp. 73-84) **Spent fuel management in France.** Hammer, P. (CEA, Paris (France). Direction des Technologies). International Atomic Energy Agency, Vienna (Austria). Dec 1988. (CONF-8803217–: Advisory group meeting on spent fuel management: Current status and prospects, Vienna, Austria, 15-18 Mar 1988). In *Spent fuel management: Current status and prospects. Proceedings of an advisory group meeting held in Vienna, 15-18 March 1988.* Order Number DE89618148/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

France's programme is best characterized as a closed fuel cycle including reprocessing and use of breeder reactors. The present nuclear installed capacity is 50 GWe corresponding to 53 units. The chosen spent fuel management scheme is that of reprocessing. National programme and experience on storage, reprocessing and transport of spent nuclear fuel and contracts for reprocessing of spent fuel from different countries are described. (author). 6 figs.

33238 (IAEA-TECDOC–487, pp. 85-96) **LWR spent fuel management in the Federal Republic of Germany.** International Atomic Energy Agency, Vienna (Austria); Siemens AG Unternehmensbereich KWU, Erlangen (Germany, F.R.). Dec 1988. (CONF-8803217–: Advisory group meeting on spent fuel management: Current status and prospects, Vienna, Austria, 15-18 Mar 1988). In *Spent fuel management: Current status and prospects. Proceedings of an advisory group meeting held in Vienna, 15-18 March 1988.* Order Number DE89618148/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

The spent fuel management strategy in the Federal Republic of Germany is based on interim storage (space for approx. 9,600 tU is available or under construction) and subsequent reprocessing of spent fuel (a 350 t/a reprocessing plant is under construction since 12/85). The waste will be disposed of in a geological repository. The non-heat producing waste will be disposed of in Konrad mine (plan approval is expected in 1989, operation licence in the first half of the 90's). The heat producing waste will be disposed of in Gorleben (below ground exploration initiated in 9/86). In parallel, alternative back-end fuel cycle techniques such as the direct disposal of spent fuel without reprocessing are being investigated and might at a later date be used for disposal of spent fuel which is not suitable for reprocessing. (author). 14 refs.

33239 (IAEA-TECDOC–487, pp. 97-108) **Status of the Swedish nuclear waste management programme.** Bjurstroem, S. (Swedish Nuclear Fuel and Waste Management Co., Stockholm (Sweden)). International Atomic Energy Agency, Vienna (Austria). Dec 1988. (CONF-8803217–: Advisory group meeting on spent fuel management: Current status and prospects, Vienna, Austria, 15-18 Mar 1988). In *Spent fuel management: Current status and prospects. Proceedings of an advisory group meeting held in Vienna, 15-18 March 1988.* Order Number DE89618148/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

A complete system has been planned for the management of all residues from the 12 reactors and research facilities. The main strategy for the spent fuel management is direct disposal without reprocessing. Essential parts of the waste management system are already in operation. The central interim storage facility for spent fuel, CLAB, has been in operation since 1985. The sea transport system has been in use since 1982 and the construction work for the final repository for reactor waste SFR is finished and start of operation is scheduled for April 1988. The remaining parts of the system for which decision has not been taken are a conditioning of encapsulation plant for spent fuel and a repository for the long-lived waste. The R and D programme is concerned with these facilities which according to present plans will be constructed after the year 2010. (author). 7 figs.

33240 (IAEA-TECDOC–487, pp. 109-112) **Spent fuel management in Switzerland.** Ospina, C. (Paul Scherrer Inst. (PSI), Wuerenlingen (Switzerland)). International Atomic Energy Agency, Vienna (Austria). Dec 1988. (CONF-8803217–: Advisory group meeting on spent fuel management: Current status and prospects, Vienna, Austria, 15-18 Mar 1988). In *Spent fuel management: Current status and prospects. Proceedings of an advisory group meeting held in Vienna, 15-18 March 1988.* Order Number DE89618148/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

Nuclear power was introduced already 18 years ago in Switzerland and it accounts today five nuclear power reactors with a total capacity of about 3000 MWe and supplies about 40% of the electricity production. The nuclear licensing requires that a firm programme of action should show that the management of all radioactive wastes and their final disposal can be accomplished. Different projects and research activities have been presented in the so-called project "Gewaehr" - 1985, aiming at demonstration of technical feasibility of radwaste disposal in Switzerland as well as all intermediate steps as required including intermediate storage of spent fuel and radwaste.

33241 (IAEA-TECDOC–487, pp. 113-128) **Current status of spent fuel management in Japan.** Watanabe, K. (Science and Technology Agency, Tokyo (Japan). Atomic Energy Bureau); Maeda, M.; Shibuya, J. International Atomic Energy Agency, Vienna (Austria). Dec 1988. (CONF-8803217–: Advisory group meeting on spent fuel management: Current status and prospects, Vienna, Austria, 15-18 Mar 1988). In *Spent fuel management: Current status and prospects. Proceedings of an advisory group meeting held in Vienna, 15-18 March 1988.* Order Number DE89618148/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

Japan now operates 35 nuclear power reactors with a combined capacity of 28 GWe. The future nuclear power generation capacity is forecasted to be at least 53 GWe in the year 2000. The basic policy of spent fuel management of Japan is to reprocess the fuel discharged and to utilize the recovered U and Pu in thermal reactors as well as in FBR. The state of the art and plans for relevant R and D activities on spent fuel storage, transportation, reprocessing for thermal reactors and FBR, recycling of recovered U and Pu, and management of HLW are described. (author). 3 figs, 2 tabs.

33242 (IAEA-TECDOC–487, pp. 129-136) **Spent fuel management strategy in the United Kingdom.** International Atomic Energy Agency, Vienna (Austria); Central Electricity Generating Board, London (UK). Dec 1988. (CONF-8803217–: Advisory group meeting on spent fuel management: Current status and prospects, Vienna, Austria, 15-18 Mar 1988). In *Spent fuel management: Current status and prospects. Proceedings of an advisory group meeting held in Vienna, 15-18 March 1988.* Order Number DE89618148/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

The paper summarises the spent fuel management strategy for commercial reactors, Magnox and AGR, in the UK. The reasons for following a reprocessing strategy for spent fuel from each reactor type are discussed, and also the rationale for the UK Generating Boards' interest in the construction of a dry storage facility for spent AGR fuel. The development of the PWR system in the UK is also dealt with. Current developments in reprocessing facilities are described, notably waste treatment plants at BNFL's Sellafield site. Finally, the prospects for uranium and plutonium recycle are considered and the position with fast reactor fuel cycle is outlined.

33243 (IAEA-TECDOC–487, pp. 137-143) **Spent fuel management in the United States of America.** International Atomic Energy Agency, Vienna (Austria); USDOE, Washington, DC (USA). Dec 1988. (CONF-8803217–: Advisory group meeting on spent fuel

management: Current status and prospects, Vienna, Austria, 15-18 Mar 1988). In *Spent fuel management: Current status and prospects. Proceedings of an advisory group meeting held in Vienna, 15-18 March 1988.* Order Number DE89618148/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

Spent fuel inventories in the USA exceed 15,000 t HM, and are increasing at a rate in excess of 1600 t per year. In the absence of reprocessing, these inventories are being stored in existing reactor fuel pools. Where initial pool storage capacity was insufficient, and structural and seismic considerations permitted, high density storage racks have been installed to increase pool storage capacity. In addition, a limited amount of spent fuel transshipment has occurred to other reactors within some utility systems where storage space was available. For the next few years there are no reactors in the United States whose continued operation is threatened because spent fuel storage space is not available or otherwise obtainable, using currently viable storage technologies. Future plans for spent fuel management, as established by US law, call for continued utility management of their spent fuel until a Federal repository or Monitored Retrievable Storage Facility (MRS) is established. When one of these Federal facilities becomes available, high-level waste or spent fuel can be transferred to it and become a federal responsibility. The spent fuel management national programme and progress in this field are presented.

33244 (IAEA-TECDOC–487, pp. 145-151) **Spent fuel management in the USSR.** International Atomic Energy Agency, Vienna (Austria); Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Dec 1988. (CONF-8803217–: Advisory group meeting on spent fuel management: Current status and prospects, Vienna, Austria, 15-18 Mar 1988). In *Spent fuel management: Current status and prospects. Proceedings of an advisory group meeting held in Vienna, 15-18 March 1988.* Order Number DE89618148/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

The nuclear power development concept adopted in the USSR foresees the reprocessing of spent fuel and recycling of the recovered nuclear fuel in thermal and fast breeder reactors. The experience and decisions taken in the USSR on storage, transport and reprocessing of spent nuclear fuel are described. (author). 4 refs.

33245 (IAEA-TECDOC–487, pp. 153-155) **Recent NEA activities related to spent fuel management.** International Atomic Energy Agency, Vienna (Austria); Nuclear Energy Agency, 75 - Paris (France). Dec 1988. (CONF-8803217–: Advisory group meeting on spent fuel management: Current status and prospects, Vienna, Austria, 15-18 Mar 1988). In *Spent fuel management: Current status and prospects. Proceedings of an advisory group meeting held in Vienna, 15-18 March 1988.* Order Number DE89618148/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

The recent past and future activities relevant to spent fuel management in OECD/NEA are introduced. The importance of continuous good cooperation and coordination between NEA and IAEA is stressed and some proposals stated.

33246 (INIS-mf–11452) **Instructions for processing programs for transport, storage and handling of nuclear fuel and for programs of basic critical experiments on nuclear research installations.** Bezpecnost Jadernych Zarizeni. (no.2). Ceskoslovenska Komise pro Atomovou Energii, Prague (Czechoslovakia). 1988. 16p. (In Czech). Order Number DE89618162/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Bezpecnost Jadernych Zarizeni.; (no.2).

Selected basic demands are listed relating to nuclear safety assurance during the transport, storage and handling of fuel and during the performance of critical experiments, including methodological instructions for processing the respective programs and their recommended syllabi. (J.B.).

0510 Marketing, Economics, and By-products

Refer also to citation(s) 33222

33247 (IAEA-TECDOC–492, pp. 21-36) **Brief analysis of the supply and demand of uranium.** Rojas, J.L. (International Atomic Energy Agency, Vienna (Austria). Div. of Nuclear Fuel Cycle). International Atomic Energy Agency, Vienna (Austria). Jan 1989. (CONF-8711306–: Technical committee meeting on in situ leaching of uranium: Technical, environmental and economic aspects, Vienna, Austria, 3-6 Nov 1987). In *In situ leaching of uranium: Technical, environmental and economic aspects. Proceedings of a technical committee meeting held in Vienna, 3-6 November 1987.* Order Number DE89617917/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

Based on the most recent updates of nuclear capacity forecasts, the evolution of the installed nuclear power in the World is analysed, considering the WOCA and socialist countries till the year 2010. From these forecasts, the uranium requirements in WOCA countries is studied. The forecasts of the most well known institutions have been included and two scenarios have been established. The uranium resources of the last Red Book have been compared with the requirements and the future uranium production have been classified in these categories, depending on the degree of expectancy to be put in future operation. Considering all these things the interaction between supply and demand have been established in the horizon of the year 2010. (author). 5 figs, 9 tabs.

0520 Waste Management

Refer also to citation(s) 33126, 33232, 33233, 33235, 33239, 33240, 33242, 33525, 33527, 33582, 33905, 33912, 34098, 34131, 34132, 34133, 34134, 34136, 34479, 34504, 34506, 34508, 34509, 34725

33248 (AECL–9078) **Effect of organic matter in clay sealing materials on the performance of a nuclear fuel waste disposal vault.** Oscarson, D.W.; Stroes-Gascoyne, S.; Cheung, S.C.H. Atomic Energy of Canada Ltd., Pinawa, MB (Canada). Whiteshell Nuclear Research Establishment. Dec 1986. 30p. Order Number DE89620393/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The potential effect of organic matter in clay sealing materials on the performance of a nuclear fuel waste disposal vault was examined. The available data indicate that the engineering properties of clays are not significantly affected by the relatively low levels of organic matter (< 1.2 wt.%) present in the clay sealing materials. Complexing of radionuclides by organic substances that are released from the clay sealing materials or produced by microorganisms will likely inhibit rather than promote radionuclide mobility in the compacted sealing materials because of the relatively large size of organic complexing species. Decreasing the level of organic matter in the clay sealing materials will not eliminate microorganisms, and perhaps not decrease their numbers significantly, because chemolithotrophic microorganisms (microorganisms that utilize inorganic forms of C) will be present in a disposal vault. Furthermore, an examination of the nutrient budget in a disposal vault indicates that N, rather than C, will likely be the limiting nutrient for microbial growth. Finally, there is not suitable, proven method for decreasing the level of organic matter in the large amounts of clay needed to seal a vault. It is concluded that the organic matter present in the clay sealing material will not adversely affect the performance of a disposal vault.

33249 (AERE-G–4977) **Transport of gases through concrete. Annual progress report, 1988.** Atkinson, A.; Claisse, P.A.; Harris, A.W.; Nickerson, A.K. UKAEA Harwell Lab. (UK). Materials Development Div. Jan 1989. 30p. Order Number DE89618316/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Gases will be generated within a radioactive waste repository. The magnitude of the gas pressure caused by the build-up of such gases will depend on the relative rates of gas generation and release from the repository. An increase in the gas pressure has the potential to affect the integrity of the repository structure. This structure will be mainly comprised of materials based on hydraulic cements (concretes and grouts) which exhibit some degree of permeability. It is essential, therefore, to understand the migration of gases through structures composed of such materials so that any deleterious effects can be avoided in the design of the repository. The bulk of the gas produced will be hydrogen, from the anaerobic corrosion of steels. The contribution from methane produced by the

degradation of organic components in the waste may also be significant. The object of this work is to quantify the gas migration rate in several different types of cementitious material as a function of both gas pressure and the degree of water saturation and to establish whether the pressures likely to be achieved in a repository can cause the expected transition to bulk flow migration in water-saturated concrete. This report details progress made during the first year of the research programme.

33250 (AERE-R–13318) **Preparation of fully-active Synroc and its radiation stability. Final report.** Boult, K.A.; Dalton, J.T.; Evans, J.P.; Hall, A.R.; Inns, A.J.; Marples, J.A.C.; Paige, E.L. UKAEA Harwell Lab. (UK). Chemistry Div.; Department of the Environment, London (UK). Oct 1988. 102p. (DOE-RW–89.009). Available from H.M. Stationery Office, London, price Pound 14.50.

Samples of Synroc have been made from fully-active waste with a composition chemically equivalent to that which will arise from the Thermal Oxide Reprocessing Plant (THORP) at Sellafield. The samples have an activity of 20 $GBq.g^{-1}$ and leach-rates, for Cs-137 and Sr-90, measured at 90°C, were about 20 and 100 times lower than for equivalent fully-active glass samples. The actinide leach rates were significantly higher than the nearest equivalent samples made at Australian Nuclear Science and Technology Organisation (ANSTO), by a factor of 3 for Cm-244 and by a factor of 200 for Pu-239. The major cause is thought to be due to premature neutralisation of the waste solution during manufacture, leading to incomplete actinide incorporation in the Synroc phases. The actinide leach rates for the fully-active samples were nevertheless 15 to 450 times less than those for fully active glass samples. Synroc samples doped with Pu-238 and Cm-244 have also been made to test the material's radiation stability. Some Pu-238 doped samples made earlier from less well characterised materials, but with the correct phase composition, have decreased in density by about 6% after a dose equivalent to 300,000 years for real waste.

33251 (CEA-CONF–9704) **Fusion process for metallic wastes slightly contaminated by radioactive substances.** Doucet, C. CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Protection contre les Rayonnements. 1988. 15p. (In French). (CONF-8810305–: 15. Meeting of the Association pour les Techniques et les Sciences de Radioprotection on Dismantling of Nuclear Plants, Wastes and Associated Problems of Radiation Protection, Grenoble, France, 5-7 Oct 1988). Order Number DE89781559/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

To ameliorate the management of metallic wastes lightly contaminated by radioactive substances and coming from nuclear installations dismantling, the Radiation Protection Service of Saclay has undertaken the study of fusion process for these wastes. After the installation description, the fusion operating mode is described. Some results of testing are given. The tests realized until now, with an industrial furnace, demonstrate the interest of a such method for metallic wastes treatment.

33252 (CEA-DAS–543) **Evaluation of the damages in rocks caused by the construction of a repository.** Devillers, C.; Escalier des Orres, P.; Hoorelbeke, J.M. CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete. Dec 1988. 12p. (In French). (CONF-880497–: Workshop on excavation effects on the engineering design and safety performance of an underground repository for radioactive waste, Winnipeg, Canada, 26-28 Apr 1988). Order Number DE89781420/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The Commissariat a l'Energie Atomique (French Atomic Energy Commission) has conducted a bibliographic study of the damages in the rock caused by the construction of a repository, and several hydraulic simulations, to appreciate the influence of these damages on the safety of the repository. These studies have led to the proposal of construction techniques in accordance safety requirements and industrial feasibility.

33253 (CNEA-NT–24/87) **Geostatistical investigations of rock masses. The Sierra del Medio Case (Argentina).** Matar, J.A.; Sarquis, M.A.; Girardi, J.P.; Tabbia, G.H. Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Gerencia de Proteccion Radiologica y Seguridad. 1987. 13p. (CNEA-REPO–28). Order Number DE89620394/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Work presented at the 5o. Congreso Internacional sobre Geologia Aplicada a la Ingenieria, Buenos Aires (Argentina), 20-25 Octubre 1986.

The geostatistical tehniques applied for the selection of a minimun fracturation volume in Sierra del Medio allow to quantify and qualify the variability of mechanic characteristics and density of fracture and also the level of reliability in estimations. The role of geostatistics is discussed in this work so as to select minimun fracturation blocks as a very important site selection step. The only variable used is the 'jointing density' so as to detect the principal fracture systems affecting the rocky massif. It was used on the semivariograms corresponding to the previously mentioned regionalized variables. The different results of fracturation are compared with the deep and shallow geological survey to obtain two and three dimensional models. The range of the geostatistical techniques to detect local geological phenomena such as faults is discussed. The variability model obtained from the borehole data computations is investigated taking as basis the vertical Columnar Model of Discontinuity (fractures) hypothesis derived from geological studies about spatial behaviour of the joint systems and from geostatistical interpretation.

33254 (CONF-890207–33) **An assessment of issues related to determination of time periods required for isolation of high level waste.** Cohen, J.J.; Daer, G.R.; Smith, C.F.; Vogt, D.K.; Woolfolk, S.W. Science Applications International Corp., Las Vegas, NV (USA). 1989. 18p. Sponsored by DOE Radioactive Waste Management. DOE Contract AC08-87NV10576. From Waste management '89; Tucson, Arizona, USA; 26 Feb - 2 mar 1989. Order Number DE89013090/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A commonly held perception is that disposal of spent nuclear fuel or high-level waste presents a risk of unprecedented duration. The EPA requires that projected releases of radioactivity be limited for 10,000 years after disposal with the intent that risks from the disposal repository be no greater than those from the uranium ore deposit from which the nuclear fuel was originally extracted. This study reviews issues involved in assessing compliance with the requirement. The determination of compliance is assumption dependent primarily due to uncertainties in dosimetric data, and relative availability of the radioactivity for environmental transport and eventual assimilation by humans. A conclusion of this study is that, in time, a spent fuel disposal repository such as the projected Yucca Mountain Project Facility will become less hazardous than the original ore deposit. Only the time it takes to do so is in question. Depending upon the assumptions selected, this time period could range from a few centuries to hundreds of thousands of years considering only the inherent radiotoxicities. However, if it can be assumed that the spent fuel radioactivity emplaced in a waste repository is less than 1/10 as available for human assimilation than that in a uranium ore deposit, then even under the most pessimistic set of assumptions, the EPA criteria can be considered to be complied with. 24 refs., 5 figs., 2 tabs.

33255 (CONF-890421–10) **The influence of penetrating gamma radiation on the reaction of simulated nuclear waste glass in tuff groundwater.** Ebert, W.L.; Bates, J.K.; Abrajano, T.A. Jr.; Gerding, T.J. Argonne National Lab., IL (USA). 1989. 19p. Sponsored by DOE Radioactive Waste Management. DOE Contract W-31109-ENG-38. From 91. annual meeting of the American Ceramic Society; Indianapolis, Indiana, USA; 23-27 Apr 1989. Order Number DE89014671/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Static leaching experiments have been performed to determine the influence of penetrating gamma radiation on the reaction of simulated nuclear waste glass in tuff groundwater at 90°C. Both the leachates and the reacted glass monoliths were analyzed to characterize the reaction. Radiation was seen to acidify the leachates, but the high bicarbonate content of the groundwater prevented the pHs from dropping below 6.4. The glass reaction tended to raise the pH. Glass based on SRL 165 black frit and PNL 76-68 glass compositions were leached. The SRL 165 type glasses were quite durable and unaffected by radiation [NL(B) ~4 g/m^2 after 278 days at all exposure rates]. The PNL 76-68 glasses were much less durable, with

the durability decreasing as the exposure rate was increased [NL(B) was about 20 g/m^2 after 278 days at 1 x 10^3 R/h for both ATM-1c and ATM-8 glasses]. 8 refs., 5 figs.

33256 (CONF-890619–2) **Waste classification - history, standards, and requirements for disposal.** Kocher, D.C. Oak Ridge National Lab., TN (USA). 27 Jun 1989. 83p. Sponsored by DOE Energy Research. DOE Contract AC05-84OR21400. From 34. annual meeting of the Health Physics Society; Albuquerque, New Mexico, USA; 25-29 Jun 1989. Order Number DE89013705/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

This document contains an outline of a presentation on the historical development in US of different classes (categories) or radioactive waste, on laws and regulations in US regarding classification of radioactive wastes; and requirements for disposal of different waste classes; and on the application of laws and regulations for hazardous chemical wastes to classification and disposal of naturally occurring and accelerator-produced radioactive materials; and mixed radioactive and hazardous chemical wastes.

33257 (DOE/NE/44139–40) **Preliminary design of the high-level waste canister storage system: Topical report for the period of January 1, 1987–September 30, 1987.** Peters, F.E.; Leap, D.R. West Valley Nuclear Services Co., Inc., West Valley, NY (USA). Nov 1987. 27p. Sponsored by DOE Nuclear Energy. DOE Contract AC07-81NE44139. Order Number DE89012367/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The final stage of the West Valley solidification program will be to place the high-level waste canisters in interim storage until a federal repository is ready to receive them. The waste canisters will be stored in the largest former fuel reprocessing cell at West Valley modified for this purpose. This report provides a description of the preliminary design of the Waste Canister Storage Facility. 9 refs., 14 figs., 1 tab.

33258 (DOE/OR/20722–208) **Performance monitoring report for the Niagara Falls Storage Site Waste Containment Structure, Lewiston, New York: Calendar year 1987 and January–June of 1988.** Blanke, J.A.; Johnson, R.T.; Stanley, W.F. Bechtel National, Inc., Oak Ridge, TN (USA). Jan 1989. 53p. Sponsored by DOE Nuclear Energy. DOE Contract AC05-81OR20722. Order Number DE89014791/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

A performance monitoring program has been developed for the Niagara Falls Storage Site (NFSS) Waste Containment Structure (WCS). The WCS contains soils contaminated with residual radioactive materials, rubble, and radioactive residues removed from various areas of the NFSS and vicinity properties during remedial action conducted by the Department of Energy (DOE) from 1982 through 1986. The NFSS is a part of the DOE Surplus Facilities Management Program (SFMP). The purpose of the performance monitoring program is to verify that the WCS main engineering elements are functioning to minimize infiltration of rainfall; prevent pollution of groundwater; preclude formation of leachate; and prevent radon emanation. This report presents the findings of performance monitoring conducted at the WCS during calendar year 1987, and January through June of 1988. the data received during the initial performance monitoring period in 1986 (Ref. 3) established a baseline for interpretation contained in this report. The period covered by this report has been expanded to include 6 months in 1988 because the impact of the winter is most evident in the spring growing season. 5 refs., 12 figs., 8 tabs.

33259 (DOE-RW–87.128) **Chemical speciation modelling of the South Terras and Madeira Abyssal Plain natural analogue sites.** Duffield, J.R.; Xu Langqui; Williams, D.R. Department of the Environment, London (UK). Nov 1988. 40p. (APCM–56). Order Number DE89617422/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The chemical speciation of uranium has been modelled using field data from the South Terras and Madeira Abyssal Plain natural analogue sites. In general, validation is good, particularly for the Abyssal Plain model. Problems regarding uranium redox couples have been highlighted as have other areas requiring further consideration for building into the thermodynamic models.

33260 (DOE-RW–89.022) **Summary report of a seminar on geosphere modelling requirements of deep disposal of low and intermediate level radioactive wastes.** Piper, D.; Paige, R.W.; Broyd, T.W. Department of the Environment, London (UK). Feb 1989. 41p. (WSA-TR–21). Order Number DE89618317/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A seminar on the geosphere modelling requirements of deep disposal of low and intermediate level radioactive wastes was organised by WS Atkins Engineering Sciences as part of Her Majesty's Inspectorate of Pollution's Radioactive Waste Assessment Programme. The objectives of the seminar were to review geosphere modelling capabilities and prioritise, if possible, any requirements for model development. Summaries of the presentations and subsequent discussions are given in this report.

33261 (DOE/RW–0219) **Information services directory: An Update of 5/87.** USDOE Office of Civilian Radioactive Waste Management, Washington, DC (USA). Mar 1989. 43p. Sponsored by DOE Radioactive Waste Management. Available from OSTI.

The Information Services Directory is intended to facilitate dissemination of information. The Directory is produced by the Information Services Division of OCRWM's Office of External Relations and Policy and will be updated periodically. This is the second such update since its issuance in August 1986. It is a reference document that lists the sources of program information available to States, Indian Tribes and the public. Chapter I of this Directory describes current program information sources, including the OCRWM Bulletin, the Electronic Bulletin Board (INFOLINK) and other periodic publications produced by OCRWM and DOE's Office of Scientific and Technical Information (OSTI). Chapter II is an index of DOE, State and Federal Agency contacts. Chapter III provides a directory of DOE technical information and includes descriptions of computerized data bases and other resources. Chapter IV enumerates Congressional Committees and Subcommittees that have jurisdiction over various components of the Civilian Radioactive Waste Management Program, and Chapter V lists DOE Reading Rooms and Information Offices, NRC Local Public Document Rooms, and public libraries in the State of Nevada that are on one or more of OCRWM's mailing lists. Chapter VI is an index of systems and Chapter VII offers listings of selected publications.

33262 (DOE/RW–0236) **Analysis of the total system life cycle cost for the Civilian Radioactive Waste Management Program.** USDOE Office of Civilian Radioactive Waste Management, Washington, DC (USA). May 1989. 190p. Sponsored by DOE Radioactive Waste Management. Available from OSTI.

The total-system life-cycle cost (TSLCC) analysis for the Department of Energy's (DOE) Civilian Radioactive Waste Management Program is an ongoing activity that helps determine whether the revenue-producing mechanism established by the Nuclear Waste Policy Act of 1982 – a fee levied on electricity generated in commercial nuclear power plants – is sufficient to cover the cost of the program. This report provides cost estimates for the sixth annual evaluation of the adequacy of the fee and is consistent with the program strategy and plans contained in the DOE's Draft 1988 Mission Plan Amendment. The total-system cost for the system with a repository at Yucca Mountain, Nevada, a facility for monitored retrievable storage (MRS), and a transportation system is estimated at $24 billion (expressed in constant 1988 dollars). In the event that a second repository is required and is authorized by the Congress, the total-system cost is estimated at $31 to $33 billion, depending on the quantity of spent fuel to be disposed of. The $7 billion cost savings for the single-repository system in comparison with the two-repository system is due to the elimination of $3 billion for second-repository development and $7 billion for the second-repository facility. These savings are offset by $2 billion in additional costs at the first repository and $1 billion in combined higher costs for the MRS facility and transportation. 55 refs., 2 figs., 24 tabs.

33263 (DPST–88-626) **Summary of campaigns SGM-9 and SGM-10 of the DWPF scale glass melter (U).** Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant. 15 Dec 1988. 82p. Sponsored by DOE Defense Programs. DOE Contract AC09-76SR00001. Order Number DE89013673/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

The ninth and tenth campaigns of the DWPF Scale Glass Melter were completed on 11/25/87 and 3/28/88, respectively. The slurry feed for each campaign contained the aqueous product from the Precipitate Hydrolysis Experimental Facility. The feed for SGM-9 consisted of frit 200/coupled feed with organics at 3 different concentrations, thus simulating 98%, 96%, and 90% organic removal in the feed. The feed for SGM-10 consisted of frit 168/coupled feed and organics at the highest anticipated DWPF concentration, 98% organic removal. Primary objectives of the campaigns were to study the effects of melter operating parameters on organic combustion, further examine plugging phenomena in the off-gas line, continue testing the DWPF prototypic glass samplers, and evaluate the performance of the DWPF prototypic lower explosive limit monitors. This report includes detailed discussions of feed delivery system performance, glass melting and pouring, off-gas treatment, sampling techniques, and instrumentation. Many of the results are applicable to the DWPF.

33264 (EGG-M–13387) **Representative elements: A step to large-scale fracture system simulation.** Clemo, T.M. EG and G Idaho, Inc., Idaho Falls, ID (USA). 1987. 15p. Sponsored by DOE Nuclear Energy. DOE Contract AC07-76ID01570. (CONF-870971–5: Geostatistical sensitivity and uncertainty methods for groundwater flow and radionuclide transport modeling conference, San Francisco, California, USA, 15-17 Sep 1987). Order Number DE89011129/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Large-scale simulation of flow and transport in fractured media requires the development of a technique to represent the effect of a large number of fractures. Representative elements are used as a tool to model a subset of a fracture system as a single distributed entity. Representative elements are part of a modeling concept called dual permeability. Dual permeability modeling combines discrete fracture simulation of the most important fractures with the distributed modeling of the less important fracture of a fracture system. This study investigates the use of stochastic analysis to determine properties of representative elements. Given an assumption of fully developed laminar flow, the net fracture conductivities and hence flow velocities can be determined from descriptive statistics of fracture spacing, orientation, aperture, and extent. The distribution of physical characteristics about their mean leads to a distribution of the associated conductivities. The variance of hydraulic conductivity induces dispersion into the transport process. Simple fracture systems are treated to demonstrate the usefulness of stochastic analysis. Explicit equations for conductivity of an element are developed and the dispersion characteristics are shown. Explicit formulation of the hydraulic conductivity and transport dispersion reveals the dependence of these important characteristics on the parameters used to describe the fracture system. Understanding these dependencies will help to focus efforts to identify the characteristics of fracture systems. Simulations of stochastically generated fracture sets do not provide this explicit functional dependence on the fracture system parameters. 12 refs., 6 figs.

33265 (EUR–11801) **Determination of geotechnical properties of loose ground salt as potential backfill material in an underground waste repository.** Kappei, G. Commission of the European Communities, Luxembourg (Luxembourg). 1988. 174p. (In French). Available from NTIS (US Sales Only), PC A08/MF A01.

This report summarizes the results of geotechnical laboratory tests on crushed salts, which were recently carried out at the Institut fur Teiflagerung of the GSF. The work is part of a selection procedure for suitable backfill materials for underground repositories.

33266 (HW–28121) **Release of radioactive wastes to ground.** Healy, J.W. General Electric Co., Richland, WA (USA). Hanford Atomic Products Operation. 20 May 1953. 24p. Sponsored by DOE Environment Health & Safety. DOE Contract AC06-76RL01830. Order Number DE89013137/JAW. Available from NTIS, PC A03/MF A01 - OSTI.

Declassified 11 Mar 1985.

Recent advances in the information available from studies in Geology, Hydrology, and Soil Science, conducted by the Biophysics Section, have indicated a need for a revision in the waste disposal policies in the separations areas. Fortunately, the present data indicate that past policies may have been conservative, and that some increase in the levels cribbed may be allowed. This report is intended to review some of the data available from present disposal practices and to indicate in a qualitative manner the developments in these various sciences that prompt the review. Also discussed are those regions where additional data are needed before major changes in the policy may be permitted.

33267 (INFO–0246) **Verification and validation for waste disposal models.** Atomic Energy Control Board, Ottawa, ON (Canada); INTERA Technologies, Ottawa, ON (Canada). Jul 1987. 76p. Order Number DE89620405/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

A set of evaluation criteria has been developed to assess the suitability of current verification and validation techniques for waste disposal methods. A survey of current practices and techniques was undertaken and evaluated using these criteria with the items most relevant to waste disposal models being identified. Recommendations regarding the most suitable verification and validation practices for nuclear waste disposal modelling software have been made.

33268 (INFO–0256) **Regulatory perspectives of concept assessment.** Flavelle, Peter A. Atomic Energy Control Board, Ottawa, ON (Canada). Sep 1987. 14p. Order Number DE89620406/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The Atomic Energy Control Board is the head agency for the regulatory review of the Assessment of the Canadian Concept for Nuclear Fuel Waste Disposal being done by Atomic Energy of Canada Limited and Ontario Hydro. This paper describes the regulatory perspective of how the Concept Assessment could demonstrate the feasibility of a disposal conforming to regulatory requirements. The long-term aspects of Concept Assessment encourage the use of various predictive techniques for different time scales. Each technique will have a different potential for establishing confidence in the predictions. The predicted performance of a facility during operation should have a very high confidence, as it can be based on standard engineering calculations and the predictions can be validated later by monitoring during operation. The predictions of the transient period following closure of the facility should achieve a medium level of confidence, since they can be based on extrapolations of predictions of operational performance, using models that can be calibrated with monitoring data and with averaged input data derived from natural analog studies. Predictions based on fundamental processes will have a medium level of confidence when made to intermediate times after closure. Long-term predictions using generic or typical input data or Monte Carlo calculations of simplified models will have the least confidence and yet they can still contribute to the confidence that the disposal concept will conform to regulatory requirements.

33269 (INIS-XN–174) **Feasibility of disposal of high-level radioactive waste into the seabed. Volume 8: Review of processes near a buried waste canister.** Lanza, F. Nuclear Energy Agency, 75 - Paris (France). 1988. 136p. Order Number DE89618318/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

One of the options suggested for disposal of high-level radioactive waste resulting from the generation of nuclear power is burial beneath the deep ocean floor in geologically stable sediment formations which have no economic value. The 8-volume series provides an assessment of the technical feasibility and radiological safety of this disposal concept based on the results obtained by ten years of co-operation and infomation exchange among the Member countries participating in the NEA Seabed Working Group. This report investigates the phenomena arriving in the proximity of the waste package immersed in the sea sediments.

33270 (INIS-XN–175) **Feasibility of disposal of high-level radioactive waste into the seabed. volume 7: Review of laboratory investigations of radionuclide migration through deep-sea sediments.** Brush, L.H. Nuclear Energy Agency, 75 - Paris (France). 1988. 273p. Order Number DE89618319/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

One of the options suggested for disposal of high-level radioactive waste resulting from the generation of nuclear power is burial beneath the deep ocean floor in geologically stable sediment formations which have no economic value. The 8-volume series provides

an assessment of the technical feasibility and radiological safety of this disposal concept based on the results obtained by ten years of co-operation and information exchange among the Member countries participating in the NEA Seabed Working Group. This volume contains a review of the laboratory investigations of radionuclide migration through deep-sea sediments. In addition, it discusses the data selected for the radiological assessment, on the basis of both field and laboratory studies.

33271 (INIS-XN–176) **Feasibility of disposal of high-level radioactive waste into the seabed. Volume 6: Deep-sea biology, biological processes and radiobiology.** Pentreath, R.J.; Hargrave, B.T.; Roe, H.S.J.; Sibuet, M. Nuclear Energy Agency, 75 - Paris (France). 1988. 219p. Order Number DE89618320/JAW. Available from NTIS (US Sales Only), PC A10/MF A01 - OSTI; INIS.

One of the options suggested for disposal of high-level radioactive waste resulting from the generation of nuclear power is burial beneath the deep ocean floor in geologically stable sediment formations which have no economic value. The 8-volume series provides an assessment of the technical feasibility and radiological safety of this disposal concept based on the results obtained by ten years of co-operation and information exchange among the Member countries participating in the NEA Seabed Working Group. This report summarizes the biological description of selected sites, the means by which radionuclides could result in human exposure via seafood pathways, and the doses likely to be received by, and effects on, the deep-sea fauna.

33272 (INIS-XN–177) **Feasibility of disposal of high-level radioactive waste into the seabed. Volume 5: Dispersal of radionuclides in the oceans: Models, data sets and regional descriptions.** Marietta, M.G.; Simmons, W.F. Nuclear Energy Agency, 75 - Paris (France). 1988. 462p. Order Number DE89618321/JAW. Available from NTIS (US Sales Only), PC A20/MF A01 - OSTI; INIS.

One of the options suggested for disposal of high-level radioactive waste resulting from the generation of nuclear power is burial beneath the deep ocean floor in geologically stable sediment formations which have no economic value. The 8-volume series provides an assessment of the technical feasibility and radiological safety of this disposal concept based on the results obtained by ten years of co-operation and information exchange among the Member countries participating in the NEA Seabed Working Group. This report summarizes the development of a realistic and credible methodology to describe the oceanic dispersion of radionuclides for risk assessment calculations.

33273 (INIS-XN–178) **Feasibility of disposal of high-level radioactive waste into the seabed. Volume 4: Engineering.** Hickerson, J.; Freeman, T.J.; Boisson, J.Y.; Murray, C.N.; Gera, F.; Nakamura, H.; Nieuwenhuis, J.D.; Schaller, K.H. Nuclear Energy Agency, 75 - Paris (France). 1988. 236p. Order Number DE89618322/JAW. Available from NTIS (US Sales Only), PC A11/MF A01 - OSTI; INIS.

One of the options suggested for disposal of high-level radioactive waste resulting from the generation of nuclear power is burial beneath the deep ocean floor in geologically stable sediment formations which have no economic value. The 8-volume series provides an assessment of the technical feasibility and radiological safety of this disposal concept based on the results obtained by ten years of co-operation and information exchange among the Member countries participating in the NEA Seabed Working Group. This report summarizes work performed to develop and evaluate engineering methods of emplacing high level radioactive waste in stable, deep ocean sediments. It includes results of desktop studies, laboratory experiments and field tests conducted in deep water.

33274 (INIS-XN–179) **Feasibility of disposal of high-level radioactive waste into the seabed. Volume 3: Geoscience characterization studies.** Shephard, L.E.; Auffret, G.A.; Buckley, D.E.; Schuettenhelm, R.T.E.; Searle, R.C. Nuclear Energy Agency, 75 - Paris (France). 1988. 318p. Order Number DE89618323/JAW. Available from NTIS (US Sales Only), PC A14/MF A01 - OSTI; INIS.

One of the options suggested for disposal of high-level radioactive waste resulting from the generation of nuclear power is burial beneath the deep ocean floor in geologically stable sediment formations which have no economic value. The 8-volume series provides an assessment of the technical feasibility and radiological safety of this disposal concept based on the results obtained by ten years of co-operation and information exchange among the Member countries participating in the NEA Seabed Working Group. This report summarizes the results of a study performed to establish if, on the basis of available data, sites may be found that will satisfy the geoscience requirements for a potential subseabed high-level waste repository.

33275 (INIS-XN–180) **Feasibility of disposal of high-level radioactive waste into the seabed. Volume 2: Radiological assessment.** Marsily, G. de; Berhendt, V.; Ensminger, D.; Flebus, C.; Hutchinson, B.; Kane, P.; Karpf, A.; Klett, R.; Mobbs, S.; Poulin, M. Nuclear Energy Agency, 75 - Paris (France). 1988. 325p. Order Number DE89618324/JAW. Available from NTIS (US Sales Only), PC A14/MF A01 - OSTI; INIS.

One of the options suggested for disposal of high-level radioactive waste resulting from the generation of nuclear power is burial beneath the deep ocean floor in geologically stable sediment formations which have no economic value. The 8-volume series provides an assessment of the technical feasibility and radiological safety of this disposal concept based on the results obtained by ten years of co-operation and information exchange among the Member countries participating in the NEA Seabed Working Group. This report presents the results of the radiological assessment which consists in estimating the detriment to man and to the environment which could result from the disposal of high level nuclear waste within seabed sediments in the deep oceans.

33276 (INIS-XN–181) **Feasibility of disposal of high-level radioactive waste into the seabed. Volume 1: Overview of research and conclusions.** Nuclear Energy Agency, 75 - Paris (France). 1988. 66p. Order Number DE89618325/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

One of the options suggested for disposal of high-level radioactive waste resulting from the generation of nuclear power is burial beneath the deep ocean floor in geologically stable sediment formations which have no economic value. The 8-volume series provides an assessment of the technical feasibility and radiological safety of this disposal concept on the results obtained by ten years of co-operation and information exchange among the Member countries participating in the NEA Seabed Working Group. This volume provides an overview of the research and a summary of the results.

33277 (K/QT–301) **Thermal properties evaluation of insulation in overpack containers for UF_6 transport.** Frazier, J.L. Oak Ridge Gaseous Diffusion Plant, TN (USA). 1989. 8p. Sponsored by DOE Nuclear Energy. DOE Contract AC05-84OT21400. (CONF-890631–39: International symposium on packaging and transporting of radioactive materials, Washington, D.C., USA, 11-16 Jun 1989). Order Number DE89013522/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Two types of insulation are currently in use in overpacks utilized to protect UF_6 during transport. Phenolic foam has been used in the family of UF_6 overpacks under US Department of Transportation Specifications. Recently new generation overpacks have been developed which utilize polyurethane foam. A comparative analysis was made of the thermal characteristics of the phenolic foam with that of polyurethane in two different densities. Thermal properties of materials vary with temperature with the relationship being a complex interaction of basic materials properties, processing variables, and environmental conditions. The need to incorporate temperature dependent thermal properties into analytical finite element codes led to an experimental program to measure thermal properties, principally thermal conductivity, for the 21PF-1 overpack phenolic foam. The thermal conductivity-temperature relationship for this insulator has been measured from room temperature to over 1000F. An alternate UF_6 product cylinder overpack container has recently entered service; an overpack design incorporating polyurethane as the primary thermal resistance in place of the phenolic foam in a 2 1/2 ton cylinder overpack. Elevated temperature thermal properties measurements for the polyurethane material system are presented.

33278 (LBL–25767) **Release rates in a salt repository by diffusion.** Hwang, Y.; Lee, W.W.L.; Chambre, P.L.; Pigford, T.H. Lawrence Berkeley Lab., CA (USA). Sep 1988. 14p. Sponsored by

DOE Radioactive Waste Management. DOE Contract AC03-76SF00098. (UCB-NE–4129). Order Number DE89013400/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

In a recent analysis, we predicted extremely small brine migration velocities after emplacement of waste packages. Therefore it is expected that mass transfer of radioactive species dissolved in the brine is likely to be controlled by molecular diffusion. Here we apply the analytic solutions for the rate of diffusive mass transfer of dissolved species through a porous medium predict radionuclide release from waste packages in salt. This analysis shows that for the parameter values selected here, and for containment times of over 300 years, release rates from individual waste packages in sale can meet the US Nuclear Regulatory Commission's (USNRC) performance objective for the engineered barrier system. If many waste packages are actually exposed to brine much sooner than 300 years after emplacement, it will be difficult to meet the release rate for ^{137}Cs, calculated from the USNRC regulation. In this report we present the analytic solutions and some numerical illustrations of the molecular diffusion analysis. We also compare the results with a different type of diffusion analysis in the Environmental Assessments for the potential repository sites in salt. 21 refs., 4 figs.

33279 (LBL–25768) **Pressure-driven brine migration in a salt repository.** Hwang, Y.; Chambre, P.L.; Pigford, T.H.; Lee, W.W.L. Lawrence Berkeley Lab., CA (USA). Jan 1989. 28p. Sponsored by DOE Radioactive Waste Management. DOE Contract AC03-76SF00098. (UCB-NE–4128). Order Number DE89013371/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The traditional view is that salt is the ideal rock for isolation of nuclear waste because it is "dry" and probably "impermeable." The existence of salt through geologic time is prima facie evidence of such properties. Experiments and experience at potential salt sites for geologic repositories have indicated that while porosity and permeability of salt are low, the salt may be saturated with brine. If this hypothesis is correct, then it is possible to have brine flow due to pressure differences within the salt. If there is pressure-driven brine migration in salt repositories then it is paramount to know the magnitude of such flow because inward brine flow would affect the corrosion rate of nuclear waste containers and outward brine flow might affect radionuclide transport rates. Brine exists in natural salt as inclusions in salt crystals and in grain boundaries. Brine inclusions in crystals move to nearby grain boundaries when subjected to a temperature gradient, because of temperature-dependent solubility of salt. Brine in grain boundaries moves under the influence of a pressure gradient. When salt is mined to create a waste repository, brine from grain boundaries will migrate into the rooms, tunnels and boreholes because these cavities are at atmospheric pressure. After a heat-emitting waste package is emplaced and backfilled, the heat will impose a temperature gradient in the surrounding salt that will cause inclusions in the nearby salt to migrate to grain boundaries within a few years, adding to the brine that was already present in the grain boundaries. The formulation of brine movement with salt as a thermoelastic porous medium, in the context of the continuum theory of mixtures, has been described. In this report we show the mathematical details and discuss the results predicted by this analysis.

33280 (LBL–25783) **On PVT-data, well treatment, and prepartion of input data for an isothermal gas-water-foam version of MULKOM.** Pruess, K.; Wu, Y.S. Lawrence Berkeley Lab., CA (USA). Aug 1988. 40p. Sponsored by DOE Energy Research. DOE Contract AC03-76SF00098. Order Number DE89012856/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

MULKOM is a multi-dimensional numerical model for simulating the coupled mass and heat transport of multiphase fluids in permeable media. Originally developed for geothermal reservoir simulation, MULKOM features a modular architecture which facilitates applications to a variety of flow systems of interest in subsurface resource recovery storage. The notes assembled in this report are intended to assist in applications of a particular version of MULKOM adapted for isothermal flow of gas-water-foam mixtures. Not all of these three phases need be present; for example, systems containing only gas and water may be simulated by setting foam saturation (volume fraction of foam) to a very small value. It is emphasized that the version of MULKOM described here is under continuing development; the chief shortcoming at the present time being the treatment of foam as an indestructible phase rather than as an emulsion of gas surfactant solution with texture changing in response to flow. The section on PVT treatment highlights the correlations used to calculate thermophysical properties of the foam and gas phases, and gives detailed specifications of the relative permeability treatment used. This section on well treatment describes the formulation for production and injection wells with multi-layer completions operating under combined rate and pressure constraints. Subsequently, a detailed description of input formats for specifying simulation problems is given. The appendices include statements of the governing equations for multiphase flow solved by the MULKOM simulator in continuum as well as in discretized form. 18 refs., 2 figs., 1 tab.

33281 (LBL–26672) **UCB-NE-107 user's manual.** Lee, W.W.L. Lawrence Berkeley Lab., CA (USA). Mar 1989. 12p. Sponsored by DOE Radioactive Waste Management. DOE Contract AC03-76SF00098. (UCB-NE–4132). Order Number DE89013416/JAW. Available from NTIS, PC A03/MF A01 - OSTI.

The purpose of this manual is to provide users of UCB-NE-107 with the information necessary to use UCB-NE-107 effectively. UCB-NE-107 is a computer code for calculating the fractional rate of readily soluble radionuclides that are released from nuclear waste emplaced in water-saturated porous media. Waste placed in such environments will gradually dissolve. For many species such as actinides and rare earths, the process of dissolution is governed by the exterior flow field, and the chemical reaction rate or leaching rate. However, for readily soluble species such as ^{135}Cs, ^{137}Cs, and ^{129}I, it has been observed that their dissolution rates are rapid. UCB-NE-107 is a code for calculating the release rate at the waste/rock interface, to check compliance with the US Nuclear Regulatory Commission's (USNRC) subsystem performance objective. It is an implementation of the analytic solution given below. 5 refs., 2 figs.

33282 (NAGRA-NTB–85-28) **Solidification of Swiss radioactive wastes by means of bitumen.** Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland). Nov 1988. 175p. (In German). Available from Nagra, CH-5401 Baden, Switzerland.

This report summarizes literature research work up to 1984/85 on properties of bitumen and bituminized radioactive waste. It characterizes particularly such bituminized wastes which are generated in the Swiss nuclear power programme. Radioactive co-precipitates and sludges originating from reprocessing of fuel elements and concentrates from the Nuclear Power Station at Goesgen (CH) are conditioned using bitumen. Data on reprocessing wastes are preliminary since corresponding data are not yet definitive. The report deals with chemical and physical properties. Radiation resistance, long-term behaviour, leaching of radionuclides in water and resistance to heat are additional topics of the study. Finally the report contains estimates of amounts of bituminized radioactive wastes which are to be disposed of as a consequence of the Swiss nuclear energy programme (based on the Project Gewaehr scenario of 240 GWe.a). (author) 89 refs., 47 tabs.

33283 (NEI-SE–36) **Ultimate storage of reactor wastes. Final report on safety.** Swedish Nuclear Fuel and Waste Management Co., Stockholm (Sweden). 30 Sep 1987. 241p. (In Swedish). Order Number DE89618326/JAW. Available from NTIS (US Sales Only), PC A11/MF A01 - OSTI; INIS.

The report describes the store, SFR 1, designed for final disposal of high and intermediate radioactive wastes from the Swedish nuclear power stations and from the Central Interior Storage Facility for Spent Nuclear Fuel and from other industry, research institutes and medical service. The store is located in rock more than 60 meters below bottom of the Baltic Sea. (O.S.).

33284 (NSS/R–118) **Evolution of minor active and toxic gases in repositories.** Biddle, P.; Rees, J.H.; Davies, A.A.; McGahan, D.J.; Rushbrook, P.E. United Kingdom Nirex, Ltd., Harwell (UK). Sep 1988. 33p. Order Number DE89618327/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

This study has considered a number of toxic and active gases which could potentially form in relatively small amounts in a deep repository for radioactive wastes. It has been concluded that many

of these would react under repository conditions or be highly soluble in groundwater. The minor amounts of the inert and relatively insoluble gas krypton-85 would dissolve in a small volume of repository water. The wide range of organic gases and vapours that could form in trace amounts has been shortened to a list of 21 by consideration of their toxicity, volatibility and extent of formation at a landfill site for non-radioactive waste. The amounts of the inert and inactive gas helium formed from α-particles and the decay of tritium will have only a very minor effect on the overall rate of gas production.

33285 (NUREG/CR–5235) **Thermodynamics of technetium related to nuclear waste disposal: Solubilities of Tc(IV) oxides and the electrode potential of the Tc(VII)/Tc(IV)–oxide couple.** Meyer, R.E.; Arnold, W.D.; Case, F.I.; O'Kelley, G.D. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering; Oak Ridge National Lab., TN (USA). Jun 1989. 38p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC05-84OR21400. (ORNL–6503). Available from NTIS, PC A03/MF A01 - GPO - OSTI.

Solubilities of Tc(IV) oxides have been determined in a number of solutions in the pH range 1 to 10. Technetium oxide was prepared by precipitation upon purified sand with a 30% excess of hydrazine and by electrodeposition. The oxide-covered sand was transferred to a small column, and the solutions to be studied were continuously cycled through the column. The electrodeposited oxide was formed on a platinum mesh electrode, and after careful rinsing, the solution to be studied was added to the electrolytic cell. The concentrations of total technetium and Tc(IV) species in the solutions were periodically determined by separating the oxidized and reduced technetium species using a solvent extraction procedure and counting the beta activity of the ^{99}Tc with a liquid scintillation counter. In basic solutions, the concentrations of Tc(IV) species in equilibrium with the oxide were in the range of 10^{-8} to 10^{-9} mol/L and tended to increase slightly with pH. In acid solutions the concentrations were much higher and were consistent with literature data on the hydrolytic species of Tc(IV). Solubilities appeared to reach a minimum in the intermediate pH range, and they were generally a factor of three or four lower for oxides electrodeposited in basic solutions compared to those for oxides electrodeposited from acid solution. The oxides were hydrated, and assuming a formula of $TcO_2 \cdot nH_2O$, the value of n was found to be 1.63 ± 0.28. These data can be used to estimate Tc(IV) solubilities for cases where solubility limits transport of technetium in reducing environments of high-level waste repositories. 22 refs., 7 figs., 9 tabs.

33286 (NUREG/CR–5391) **Flow of groundwater and transport of contaminants through saturated fractured geologic media.** Steele, T.D.; Kunkel, J.R.; Way, S.C.; Koenig, R.A. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering; In-Situ, Inc., Laramie, WY (USA). Jun 1989. 377p. Sponsored by Nuclear Regulatory Commission. Available from NTIS, PC A17/MF A01 - GPO - OSTI.

This report documents the results of several field investigations conducted during the early part of 1988 to characterize the Roza Member basalt aquifer of the Wanapum Formation of the Columbia River Basalt Group. A research wellfield was implemented and field tests conducted to lithologically classify subsurface geologic media and hydrologic parameters in an 800- by 1400-foot area located in the northwest quarter of Section 16, T.25N, R.34E, six miles south of the town of Creston in Lincoln County, Washington. This final project report assimilates the data and information generated by the study for possible eventual application to repository site characterization and performance prediction in fractured geologic media. The relatively high-yielding aquifers of the Roza Member basalt are separated by claystone aquitards and are hydrologically interrupted by at least two different subsurface hydrologic structures. Water-level data were collected over an 18-month period and used to assess seasonal variations in regional and local hydraulic gradient. Additional wellbore slug tests and two more passive (nonpumping) tracer tests enabled calculation of equivalent hydraulic apertures and effective porosities for the Roza basalt flow top. Analysis of data from two pumping tests provided a basis for calculation of transmissivities and storage coefficients for the Roza basalt. 31 refs., 97 figs., 15 tabs.

33287 (ORNL/TM–11037) **ADGEN: ADjoint GENerator for computer models.** Worley, B.A.; Pin, F.G.; Horwedel, J.E.; Oblow, E.M. Oak Ridge National Lab., TN (USA). May 1989. 102p. Sponsored by DOE Defense Programs. DOE Contract AC05-84OR21400. Order Number DE89013732/JAW. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

This paper presents the development of a FORTRAN compiler and an associated supporting software library called ADGEN. ADGEN reads FORTRAN models as input and produces and enhanced version of the input model. The enhanced version reproduces the original model calculations but also has the capability to calculate derivatives of model results of interest with respect to any and all of the model data and input parameters. The method for calculating the derivatives and sensitivities is the adjoint method. Partial derivatives are calculated analytically using computer calculus and saved as elements of an adjoint matrix on direct assess storage. The total derivatives are calculated by solving an appropriate adjoint equation. ADGEN is applied to a major computer model of interest to the Low-Level Waste Community, the PRESTO-II model. PRESTO-II sample problem results reveal that ADGEN correctly calculates derivatives of response of interest with respect to 300 parameters. The execution time to create the adjoint matrix is a factor of 45 times the execution time of the reference sample problem. Once this matrix is determined, the derivatives with respect to 3000 parameters are calculated in a factor of 6.8 that of the reference model for each response of interest. For a single 3000 for determining these derivatives by parameter perturbations. The automation of the implementation of the adjoint technique for calculating derivatives and sensitivities eliminates the costly and manpower-intensive task of direct hand-implementation by reprogramming and thus makes the powerful adjoint technique more amenable for use in sensitivity analysis of existing models. 20 refs., 1 fig., 5 tabs.

33288 (PNL–6874) **Hanford Protective Barriers Program asphalt barrier studies – FY 1988.** Freeman, H.D.; Gee, G.W. Pacific Northwest Lab., Richland, WA (USA). May 1989. 39p. Sponsored by DOE Nuclear Energy. DOE Contract AC06-76RL01830. Order Number DE89014622/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The Hanford Protective Barrier (HPB) Program is evaluating alternative barriers to provide a means of meeting stringent water infiltration requirements. One type of alternative barrier being considered is an asphalt-based layer, 1.3 to 15 cm thick, which has been shown to be very effective as a barrier for radon gas and, hence, should be equally effective as a barrier for the larger molecules of water. Fiscal Year 1988 studies focused on the selection and formulation of the most promising asphalt materials for further testing in small-tube lysimeters. Results of laboratory-scale formulation and hydraulic conductivity tests led to the selection of a rubberized asphalt material and an admixture of 24 wt% asphalt emulsion and concrete sand as the two barriers for lysimeter testing. Eight lysimeters, four each containing the two asphalt treatments, were installed in the Small Tube Lysimeter Facility on the Hanford Site. The lysimeter tests allow the performance of these barrier formulations to be evaluated under more natural environmental conditions.

33289 (POEF-A–355) **Regulations and standards improve UF_6 handling and transportation practices.** Kovac, F.M. Martin Marietta Energy Systems, Inc., Piketon, OH (USA). 31 May 1989. 7p. Sponsored by DOE Defense Programs. DOE Contract AC05-76OR00001. (CONF-890631–52: International symposium on packaging and transporting of radioactive materials, Washington, D.C., USA, 11-16 Jun 1989). Order Number DE89013805/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

No fatalities or injuries have ever occurred due to accidents involving the transportation of UF_6. However, we must not become complacent or rest on this record. Safely transporting uranium hexafluoride for over 40 years has caused many to feel confident because of the many levels of safety intended to protect the public and the environment. The intent of this paper is to emphasize several safety related concerns that we at the Portsmouth Gaseous Diffusion Plant have as a result of our experience in shipping enriched UF_6, and to review the impact of recent regulations and standards. 5 figs.

33290 (RFP–4302) **A low level/transuranic waste sorting device for plutonium assay.** Haas, F.X.; Tindall, A.L.; Giacomini, J.J. Rockwell International Corp., Golden, CO (USA). Rocky Flats

Plant. 1989. 26p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP03533. (CONF-890736–3: 30. annual meeting of the Institute of Nuclear Materials Management, Orlando, Florida, USA, 9-12 Jul 1989). Order Number DE89014688/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

An assay device is described which was designed and tested at Rocky Flats Plant to separate weapons grade plutonium waste into low-level waste and transuranic (TRU) waste at the 100 nCi/g level of contamination. It also performs waste assays up to 30 grams of plutonium in the waste container. The device consists of two shielded 4" x 4" x 16" sodium iodide detectors stacked end-on-end to form a pillar 32" high. Assays are performed on 208 liter drums (55 gallon) and on high efficiency particulate (HEPA) filters (26" x 26" x 16") rotated on a turntable in front of the detectors. Assays times are of the order of two minutes. Extensive diagnostics are incorporated into the system software to check background count rate, the intensity of built-in check sources on each detector and the response of standard packages which must be assayed at preset intervals. Detail is given to the terminal data management systems used in the applications software to make it easier to program interactive forms for data input to reduce operator data-entry error in operating the system. 6 figs.

33291 (SAND–87-1575) **Preliminary analyses of the excavation investigation experiments proposed for the exploratory shaft at Yucca Mountain, Nevada Test Site.** Costin, L.S.; Bauer, S.J. Sandia National Labs., Albuquerque, NM (USA). Dec 1988. 202p. Sponsored by DOE Radioactive Waste Management. DOE Contract AC04-76DP00789. Order Number DE89012872/JAW. Available from NTIS, PC A10/MF A01 - OSTI; GPO Dep.

The Yucca Mountain Project (YMP), is examining the feasibility of siting a repository for high-level nuclear waste at Yucca Mountain on and adjacent to the Nevada Test Site. Three excavation experiments, Shaft Convergence, Demonstration Breakout Rooms, and Sequential Drift Mining, will provide some of the data required to (1) assess the mechanical behavior of repository-size openings and (2) validate numerical models that may be used in the repository design process. In this report, the results of preliminary analyses of the three excavation experiments are presented. The major objective of these analyses was to provide some guidance to the experiment planners regarding the expected displacements and stresses near the experimental drifts so that selection and placement of instrumentation could be optimized. Further, successful completion of these analyses demonstrates the ability to model the experiments, given the simplifying assumptions presented. Limitations of the analyses performed and the experiments as currently designed are also discussed. Finally, the results of these analyses provided some indication of how the variation of some key geometric and material parameters would affect the predicted results. Once the experiment design is finalized and site-specific material data are collected, pretest predictive analyses will be conducted using the mechanical and material models that require validation. 15 refs., 123 figs., 13 tabs.

33292 (SAND–87-7174) **Studies of electrical and electromagnetic methods for characterizing salt properties at the WIPP [Waste Isolation Pilot Project] Site, New Mexico.** Skokan, C.K.; Pfeifer, M.C.; Keller, G.V.; Andersen, H.T. Colorado School of Mines, Golden, CO (USA). Dept. of Geophysics. Jun 1989. 22p. Sponsored by DOE Radioactive Waste Management. DOE Contract AC04-76DP00789. Order Number DE89012880/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

At the Waste Isolation Pilot Project Site in southeastern New Mexico, technical and engineering issues related to the long-term storage of hazardous wastes in bedded salt are being studied. For nuclear waste repositories with both long operational periods (50 yr) and long performance assessment periods (10,000 yr), the Disturbed Rock Zone (the zone of rock in which the mechanical and hydrologic properties have changed in response to excavation; abbreviated as DRZ) is important to both operational (e.g., slab or fracture failure of the excavation) and long-term performance (e.g., seal system performance and fluid transport). Because of the large contrast in electrical conductivity between crystalline salt and salt saturated with water, it is to be expected that electrical geophysical methods may play an important role in delineating portions of the DRZ. The Colorado School of Mines, under contract to Sandia National Laboratories, has carried out experimental surveys using the direct current electrical method and two electromagnetic methods underground in the mine workings. The results suggest that the various electrical methods are effective in locating low resistivity zones in the salt, which probably represent moisture-rich zones. Furthermore, it appears that such measurements might well be further optimized in terms of survey effort and design of systems to provide a high response to small- scale conductive features in the salt. 8 refs., 16 figs.

33293 (SAND–89-0372) **Waste Isolation Pilot Plant simulated waste compositions and mechanical properties.** Butcher, B.M. Sandia National Labs., Albuquerque, NM (USA). Jun 1989. 39p. Sponsored by DOE Radioactive Waste Management. DOE Contract AC04-76DP00789. Order Number DE89012873/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

Analyses of the final state of collapse of various types of contact-handled waste drums are required to assess of the performance of the waste storage areas in the Waste Isolation Pilot Plant. To provide data for calculations, tests must use simulated, instead of actual waste. Data on the contents of the principal categories of contact-handled transuranic waste from the Idaho National Engineering Laboratory were used to define standard compositions of simulated waste. Categories of baseline waste will be created by mixing appropriate amounts of the simulants together. Selection of materials is discussed. Methods for estimating the consolidation characteristics of simulated waste are also described. Theoretical solid densities, theoretical solid compressibilities, and initial void volumes of various waste components are estimated, and a method for estimating consolidation curves in the absence of experimental data is described. 9 refs., 14 figs., 11 tabs.

33294 (SAND–89-0838C) **Developing a geologic and engineering properties data base with INGRES.** Krebs-Jespersen, M.L. Sandia National Labs., Albuquerque, NM (USA). 1989. 26p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-8904194–3: INGRES User Association meeting, New Orleans, Louisiana, USA, 23-27 Apr 1989). Order Number DE89013520/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The design of a data base for storing diverse geological and site engineering properties data from various sources using the INGRES data base management system has required (1) designing tables for data that are similar but have very different test conditions to be reported, (2) determining what data is necessary to ensure that all records are unique, (3) changing, as necessary, the design of data base tables to accommodate the needs of new data submittals, (4) defining limits to comments and descriptions of test conditions to be stored in the data base, (5) solving problems caused by the limitations of the available field types in INGRES, and (6) designing a tracking system for data submissions to satisfy Project quality assurance requirements. The resulting relational data base design is simple, flexible, and capable of accommodating changes in requirements for data storage and user needs. The INGRES Report Writer utility has proven to be a powerful tool for generating reports because the Report Writer code is easily revised as table structure changes. Separate data storage tables can be joined for report production, and output can be customized for each user.

33295 (SAND–89-0940C) **Contribution to internal pressure and flammable gas concnetration in RAM [radioactive material] transport packages.** Warrant, M.M.; Brown, N. Sandia National Labs., Albuquerque, NM (USA). 1989. 8p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890631–33: International symposium on packaging and transporting of radioactive materials, Washington, D.C., USA, 11-16 Jun 1989). Order Number DE89013490/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Various facilities in the US generate wastes contaminated with transuranic (TRU) isotopes (such as plutonium and americium) that decay primarily by emission of alpha particles. The waste materials consist of a wide variety of commercially available plastics, paper, cloth, and rubber; concreted or sludge wastes containing water; and metals, glass, and other solid inorganic materials. TRU wastes that

have surface dose rates of 200 mrem/hr or less are typically packaged in plastic bags placed inside metal drums or boxes that are vented through high efficiency particulate air (HEPA) filters. These wastes are to be transported from waste generation or storage sites to the Waste Isolation Pilot Plant (WIPP) in the TRUPACT-II, a Type B package. Radiolysis of organic wastes or packaging materials, or wastes containing water generates gas which may be flammable or simply contribute to the internal pressure of the radioactive material (RAM) transport package. This paper discusses the factors that affect the amount and composition of this gas, and summarizes maximum radiolytic G values (number of molecules produced per 100 eV absorbed energy) found in the technical literature for many common materials. These G values can be used to determine the combination of payload materials and decay heats that are safe for transport. G values are established for categories of materials, based on chemical functional groups. It is also shown using transient diffusion and quasi-equilibrium statistical mechanics methods that hydrogen, if generated, will not stratify at the top of the transport package void space. 9 refs., 1 tab.

33296 (SAND–89-0959C) **1/3-scale model testing program.** Yoshimura, H.R.; Attaway, S.W.; Bronowski, D.R.; Uncapher, W.L.; Huerta, M.; Abbott, D.G. Sandia National Labs., Albuquerque, NM (USA). 1989. 9p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890631–22: International symposium on packaging and transporting of radioactive materials, Washington, D.C., USA, 11-16 Jun 1989). Order Number DE89013449/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This paper describes the drop testing of a one-third scale model transport cask system. Two casks were supplied by Transnuclear, Inc. (TN) to demonstrate dual purpose shipping/storage casks. These casks will be used to ship spent fuel from DOE's West Valley demonstration project in New York to the Idaho National Engineering Laboratory (INEL) for long term spent fuel dry storage demonstration. As part of the certification process, one-third scale model tests were performed to obtain experimental data. Two 9-m (30-ft) drop tests were conducted on a mass model of the cask body and scaled balsa and redwood filled impact limiters. In the first test, the cask system was tested in an end-on configuration. In the second test, the system was tested in a slap-down configuration where the axis of the cask was oriented at a 10 degree angle with the horizontal. Slapdown occurs for shallow angle drops where the primary impact at one end of the cask is followed by a secondary impact at the other end. The objectives of the testing program were to (1) obtain deceleration and displacement information for the cask and impact limiter system, (2) obtain dynamic force-displacement data for the impact limiters, (3) verify the integrity of the impact limiter retention system, and (4) examine the crush behavior of the limiters. This paper describes both test results in terms of measured decelerations, post test deformation measurements, and the general structural response of the system. 7 refs., 9 figs.

33297 (SAND–89-0960C) **Development of a dynamic finite element computer code for the inelastic analysis of cask structures – PRONTO 3D.** Taylor, L.M.; Flanagan, D.P.; Attaway, S.W.; Yoshimura, H.R. Sandia National Labs., Albuquerque, NM (USA). 1989. 8p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890631–41: International symposium on packaging and transporting of radioactive materials, Washington, D.C., USA, 11-16 Jun 1989). Order Number DE89013473/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The Engineering Analysis Department at Sandia National Laboratories has developed a three-dimensional transient solid dynamics computer code, PRONTO 3D, that can simulate and analyze radioactive material packaging impact and puncture events. Sphere and cask impact example problems demonstrated the contact surface algorithm and other aspects of the code PRONTO 3D has proven to be a powerful tool for analyzing problems in impact dynamics, rock blasting, and accident analyses. 4 refs., 5 figs.

33298 (SAND–89-0979C) **Identifying roadway sections with "critical" large truck accident rates.** Brogan, J.D.; Cashwell, J.W. Sandia National Labs., Albuquerque, NM (USA). 1989. 9p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890631–38: International symposium on packaging and transporting of radioactive materials, Washington, D.C., USA, 11-16 Jun 1989). Order Number DE89013521/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A technique for merging accident record and roadway inventory files and for utilizing the combined data set to identify sections of a rural interstate highway system that have unusually high accident rates involving large truck vehicles is presented here as a prototype of the accident probability methodology. This statistical technique, known as the rate/quality control method, involves calculating a "critical rate" for each roadway section. This critical rate is a function of the traffic volume on the section, the overall systemwide accident rate, and a desired level of statistical significance. Observed accident rates on each section are then compared to the section's critical rate sections are ranked according to their "criticality," that is, the numerical difference between their observed and "critical" rates. With ongoing data collection efforts and concomitant improvements in data quality, particularly involving large truck accident rates, the technique may ultimately have application to the formulation of routing decisions regarding the transport of radioactive or other hazardous materials and in the evaluation of routing alternatives. Subsequent sections of the paper describe in detail the rate/quality control technique and its application to a state-wide rural interstate highway network, develop the computer code for merging the accident and inventory files, and describe the selection of critical roadway sections. Conclusions and recommendations for further work follow. 8 refs., 2 figs., 1 tab.

33299 (SAND–89-0980C) **StateGEN/StateNET–A structured method to perform route comparisons.** Cashwell, J.W.; Erickson, C.M. Sandia National Labs., Albuquerque, NM (USA). 1989. 8p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890631–34: International symposium on packaging and transporting of radioactive materials, Washington, D.C., USA, 11-16 Jun 1989). Order Number DE89013491/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

StateGEN/StateNET is a modelling structure and routing algorithm designed expressly to address the needs of state and local governments to perform analyses of routing alternatives. StateGEN/StateNET is designed to permit the user to construct a network and assign attributes of interest to the network on a personal computer (PC). The completed network is then transferred via a modem to the TRANSNET system (Cashwell, 1989) and the preferred route is determined based upon attribute weights assigned by the user. This modelling structure permits the state or local to perform a routing analysis, such as that required by the US Department of Transportation (DOT) for Highway Route-Controlled Quantity shipments of radioactive materials, with a minimum of resources. StateGEN/StateNET provides a computerized version of the DOT guidelines (Cashwell, 1989) or allows the user to structure their own network parameters. Sandia national Laboratories (SNL) is the Department of Energy's (DOE) lead organization for transportation research and development. The DOE Office of Defense Programs has been the prime sponsor of development of models and associated databases used to analyze the impacts of the transportation of radioactive materials. The routing algorithms used in StateGEN/StateNET were based on the existing models on TRANSNET, a system which was developed to enable outside users to access analytical codes and associated data developed for the DOE. 2 refs.

33300 (SAND–89-0981C) **Demographic and transportation parameters in RADTRAN.** Brogan, J.D.; Cashwell, J.W.; Neuhauser, K.S. Sandia National Labs., Albuquerque, NM (USA). 1989. 7p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890631–46: International symposium on packaging and transporting of radioactive materials, Washington, D.C., USA, 11-16 Jun 1989). Order Number DE89013160/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This paper describes the default parameters for each of the three major variable categories – transportation network, land use, and population – in the current version of the RADTRAN code. Changes in the variable assumptions associated with the release of RADTRAN 4.0 will then be described as will the options for users to supply locally-available, rather than national-level, default values. Finally, long-term enhancements anticipated for the code will be discussed. 17 refs.

33301 (SAND–89-0982C) **TRANSNET–Access to transportation models and databases.** Cashwell, J.W. Sandia National Labs., Albuquerque, NM (USA). 1989. 8p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890631–48: International symposium on packaging and transporting of radioactive materials, Washington, D.C., USA, 11-16 Jun 1989). Order Number DE89013163/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

TRANSNET is a compilation of risk, systems analysis, routing and cost models as well as related data pertaining to radioactive materials transportation. TRANSNET is the acronym assigned to this system of models and associated data which reside on dedicated micro VAX II. After obtaining a password, users may access TRANSNET with a modern-equipped personal computer. The goals of the TRANSNET system are transfer of technology and data to qualified users by permitting access to the most comprehensive and up-to-date transportation risk and systems analysis models and associated databases. 8 refs.

33302 (SAND–89-0988C) **Radioactive material package seal technology experiments.** Kincy, M.; Humphreys, D. Sandia National Labs., Albuquerque, NM (USA). 1989. 18p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890631–47: International symposium on packaging and transporting of radioactive materials, Washington, D.C., USA, 11-16 Jun 1989). Order Number DE89013161/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Preliminary experiments have been conducted to determine the performance of several classes of seal materials under conditions representative of radioactive material package environments. Measurements of helium leak rates of seals in fixtures exposed to various environments are used to compare seal materials and seal geometries. In addition, material properties of the seals are being measured to attempt to correlate sealing performance to specific material characteristics. Initial experiments have focused on temperature effects on elastomeric O-rings. 11 figs.

33303 (SAND–89-0992C) **Highway route controlled quantity shipment routing reports: An overview.** Cashwell, J.W.; Welles, B.W.; Welch, M.J. Sandia National Labs., Albuquerque, NM (USA). 1989. 9p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890631–37: International symposium on packaging and transporting of radioactive materials, Washington, D.C., USA, 11-16 Jun 1989). Order Number DE89013519/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

United States Department of Transportation (DOT) regulations require a postnotification report from the shipper for all shipments of radioactive materials categorized as a Highway Route Controlled Quantity. These postnotification reports, have been compiled by the DOT in a database known as the Radioactive Materials Routing Report (RAMRT) since 1982. The data were sorted by each of its element to establish historical records and trends of Highway Route Controlled Quantity shipment from 1982 through 1987. Approximately 1520 records in the RAMRT database were compiled for this analysis. Approximately half of the shipments reported for the study period were from the US Department of Energy (DOE) and its contractors, with the others being commercial movements. Two DOE installations, EG and G Idaho and Oak Ridge, accounted for nearly half of the DOE activities. Similarly, almost half of the commercial movements were reported by two vendors, Nuclear Assurance Corporation and Transnuclear, Incorporated. Spent fuel from power and research reactor accounted for approximately half of all shipments. 1 ref., 7 figs., 3 tabs.

33304 (SAND–89-1007C) **An estimate of the contribution of "crud" to the radioactivity source term of a spent fuel transport cask.** Jordan, H.; Pasupathi, V.; Sanders, T.L. Sandia National Labs., Albuquerque, NM (USA). 1989. 9p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890631–32: International symposium on packaging and transporting of radioactive materials, Washington, D.C., USA, 11-16 Jun 1989). Order Number DE89013489/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

There are three sources of releasable radioactive material in a loaded, spent fuel transport cask: (1) the residual contamination activity on the cask surfaces as a result of loading operations and previous shipments, (2) fission and activation product activity associated with deposited material on the fuel assembly surfaces ("crud"), and (3) the radionuclides contained within the individual fuel rods comprising the fuel assemblies. The US regulations for the containment requirements of a spent fuel transport cask limit radionuclide release rates to 10^{-6} A_2 per hour and A_2 per week for normal and accident conditions of transport. Compliance with these release limits, R_i, may be demonstrated by directly measurable leak rates, L_i, through the mathematical expression $L_i = R_i/C_i$, (i = N for normal or A for accident conditions), where C_i represents the concentration of airborne radioactive material in the cask that could escape from the containment system for the appropriate conditions of transport. This paper describes a method for estimating the contribution to C_N and C_A due to crud and residual contaminant activity. 7 refs., 3 figs., 1 tab.

33305 (SAND–89-1137C) **RADTRAN 4.0: Advanced computer code for transportation risk assessment.** Neuhauser, K.S.; Reardon, P.C. Sandia National Labs., Albuquerque, NM (USA). 1989. 7p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890631–36: International symposium on packaging and transporting of radioactive materials, Washington, D.C., USA, 11-16 Jun 1989). Order Number DE89013518/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

RADTRAN 4.0 is a computer code for transportation risk assessment developed by Sandia National Laboratories for the US Department of Energy. While retaining the most useful and time-proven features of its predecessors, RADTRAN 4.0 incorporates significant advances over the earlier versions. The most useful new features are: improved route-specific analysis capability, internal radionuclide data library, improved logic for analysis of multiple-radionuclide packages such as spent fuel, separate treatment of gamma and neutron components of Transport Index (TI), and increased number of accident-severity categories. In this paper, each of these features will be described, and, where appropriate, potential applications will be discussed. 11 refs.

33306 (SAND–89-1285C) **Uncertainties in sealing a nuclear waste repository in partially saturated tuff.** Tillerson, J.R.; Fernandez, J.A.; Hinkebein, T.E. Sandia National Labs., Albuquerque, NM (USA). 1989. 14p. Sponsored by DOE Radioactive Waste Management. DOE Contract AC04-76DP00789. (CONF-8905136–2: Joint NEA/CEC workshop on sealing of radioactive waste repositories, Braunschweig, Germany, F.R., 22-25 May 1989). Order Number DE89012637/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Sealing a nuclear waste repository in partially saturated tuff presents unique challenges to assuring performance of sealing components. Design and performance of components for sealing shafts, ramps, drifts, and exploratory boreholes depend on specific features of both the repository design and the site; of particular importance is the hydrologic environment in the unsaturated zone, including the role of fracture flow. Repository design features important to sealing of a repository include the size and location of shaft and ramp accesses, excavation methods, and the underground layout features such as grade (drainage direction) and location relative to geologic structure. Uncertainties about seal components relate to the postclosure environment for the seals, the emplacement methods, the material properties, and the potential performance of the components. An approach has been developed to reduce uncertainties and to increase confidence in seal performance; it includes gathering extensive site characterization data, establishing conservative design requirements, testing seal components in laboratory and field environments, and refining designs of both the seals and the repository before seals are installed. 9 refs., 5 figs., 2 tabs.

33307 (SAND–89-7071C) **An historical summary of transportation accidents and incidents involving radioactive materials (1971–1988).** Cashwell, C.E.; McClure, J.D. Sandia National Labs., Albuquerque, NM (USA). 1989. 9p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890631–35: International symposium on packaging and transporting of radioactive materials, Washington, D.C., USA, 11-16 Jun 1989). Order Number DE89013527/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The Radioactive Materials Incident Report (RMIR) Database is a compilation of transportation events that have occurred during the shipment of radioactive materials. The database was developed in 1971 at the Transportation Technology Center (TTC) AT Sandia National Laboratories (SNL) to support its research and development efforts for the US Department of Energy (DOE). Currently RMIR resides on TRANSNET, an interactive computer network that allows an outside user to access transportation risk and systems analysis models and their associated databases. Within the last few months, the RMIR database has been modified so that the menu-driven format expedites database searches, particularly for the infrequent user. 2 refs.

33308 (SKB-SP-TR–88-05) **Hydrogeochemical assessment of crystaline rock for radioactive waste disposal: the Stripa experience.** Andrews, J.; Fontes, J.C.; Fritz, P.; Nordstroem, K. Swedish Nuclear Fuel and Waste Management Co., Stockholm (Sweden). Aug 1988. 39p. Order Number DE89618329/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

This report presents a program for the hydro-geochemical assessment of a crystalline rock site for radioactive waste disposal. It is based upon experience gained during the international program of hydrochemical work at the Stripa mine. The important result of this work are summarized in this report and fuller details may be found in the separate final reports of the Phase 1 and Phase 2 geochemical investigations of the Stripa groundwaters. The present report summarizes the general sampling requirements for a successful hydrochecmical investigation; the isotopic and chemical parameters which should be determined an the geochemical characterization of the rock matrix necessary for the interpretation of hydrochemistry. A general strategy for site evaluation by geochemical methods is presented. (authors).

33309 (SKB-SP-TR–88-06) **Stripa project annual report 1987.** Swedish Nuclear Fuel and Waste Management Co., Stockholm (Sweden). Jun 1988. 70p. Order Number DE89618330/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

Results under the following main headings are reported: -Crosshole techniques for the detection and characterization of fracture zones. -Site characterization and validation. -Development of high resolution and directional radar. -Improvement of techniques for high resolution borehole seismics. -Fracture network modeling. -Channelling experiment. -Estimation of fracture length and aperture from single fracture well tests. -Rock sealing.

33310 (SKI–84089) **On the swelling of ion exchange resins used in Swedish nuclear power plants.** Nilsson, A.C.; Hoegfeldt, E.; Muhammed, M.; Wingefors, S. Swedish Nuclear Power Inspectorate, Stockholm (Sweden). Mar 1988. 161p. (SKI-TR–88-1). Order Number DE89618331/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

Ion exchange resins are used in nuclear power plants for purification and decontamination of water. In some of the cases, the spent resins are solidified by drying at elevated temperatures and then molded together with bitumen before final disposal. The objective of the present work is to study the swelling behavior of such resins and describe it with a model that permits calculation of the water uptake into the bituminized resins and the external swelling pressure that might develop by the swelling resins under repository conditions. The experimental part of the study comprises the swelling of ion exchange resins upon their exposure to water vapour before and after thermal treatment under conditions simulating those used in the various solidification processes. Seven different resins were studied in different chemical forms; H^+, N^+ and OH^-, So_4^{2-} for the cation an anion exchangers respectively. For each resin, water uptake, density and volume were measured at different water activities at 25 degrees C. The swelling pressure for all resins studied was calculated. A slight increase in swelling pressure after thermal treatment could be observed, especially for anion exchangers. The apparent molar volume of water in the resin phase has been determined and the swelling free energies of swelling has been calculated from experimental data at 25 degrees C and estimated at 0 degrees C. (authors).

33311 (SSI–88-05) **Examining memorandum: Ultimate store for nuclear reactor wastes - SFR-1.** Bergman, C.; Ericsson, G.; Godaas, T.; Haegg, C.; Johansson, G. National Inst. of Radiation Protection, Stockholm (Sweden). 28 Mar 1988. 80p. (In Swedish). Order Number DE89618332/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

The report constitutes the basis for the position of the National Institute of Radiation Protection as regards permission to operate SFR-1 at Forsmark. The memorandum describes: - existing conditions regarding commissioning SFR-1, - summarily the final safety report from the Swedish Fuel and Waste Management Co, - consultant contributions ordered in connection with the examination, - the judgement of the institute in all questions relevant to radiation protection conditions in SFR-1. The institute has made it's own estimates of the radiation doses the repository could be the source of. It is concluded that the radiation doses from the repository are acceptable and consequently operation permission is recommended. (O.S.).

33312 (UCID–21466) **Simulations of the near-field transport of radionuclides by liquid diffusion at Yucca Mountain: Comparisons with and without emplacement backfill.** Nitao, J.J. Lawrence Livermore National Lab., CA (USA). Jul 1988. 24p. Sponsored by DOE Radioactive Waste Management. DOE Contract W-7405-ENG-48. Order Number DE89013383/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The possible set of hydrologic conditions at the Yucca Mountain repository site includes the case where groundwater recharge fluxes are sufficiently low relative to molecular diffusion in the rock so that, in the region around the waste package, the dominant mode of aqueous transport of radionuclides is by diffusion. Although the rock at the repository level is unsaturated, a sufficient amount of pore water could form a contiguous diffusion path from the waste form to the near-field rock if the waste is postulated to be in contact with the rock or emplacement backfill due to failure of the container. Future simulations will have to include conditions where the effects of convective transport in the rock are important in aqueous transport. We consider in this report simplified simulations of one-dimensional transport of radionuclides in the rock due to liquid molecular diffusion in order to determine the effects of an emplacement backfill. Comparison of estimated release rates with and without an emplacement backfill were given in an article by Chambre and Pigford [1984], and these values were referenced in our previous report. Here, we have extended their calculations to include estimates using the physical parameters expected at the Yucca Mountain repository site. Our model is a simple one-dimensional treatment of diffusion in a spherically symmetric geometry that takes into account the sorptive effects of the tuff and backfill through the use of K_d values. This geometry rather than a cylindrical one was chosen because it is conservative in predicting higher release rates. Radioactive decay is included, and only one species at a time is treated. The dissolution of the radionuclides is assumed to be solubility-limited. 12 refs., 13 figs., 1 tab.

33313 (UCID–21542-89-1) **Plutonium residue recovery (PuRR) project: Quarterly progress report, January–March 1989.** Alire, R.M.; Gregg, D.W.; Hickman, R.G.; Kuhl, W.D.; Landrum, J.H.; Johnson, G.K.; Johnson, I.; Mulcahey, T.P.; Pierce, R.D.; Poa, D.S. Lawrence Livermore National Lab., CA (USA). 26 May 1989. 33p. Sponsored by DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE89013713/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This quarterly report presents experimental and conceptual design information covering the development of a new pyrochemical process to recover weapons-grade plutonium from and reduce the amount of aqueous process intractable transuranic (TRU) residues now stored at Department of Energy facilities. During this period, experiments were performed in which zinc-calcium alloys were used to reduce the Rocky Flats ash heel. They offer potential advantages to reduce wastes because of reagent recycle. One reduction run using zinc-10 wt % calcium alloy was 99.7% complete. In another run, the calcium was titrated into the zinc alloy to observe the stepwise progression of the reduction. In support of planned electrochemical recovery of calcium, experiments were performed to determine the solubility of calcium $CaCl_2$-CaF_2 in the presence of zinc-calcium alloys. Also, initial experiments with reference electrodes for electrochemical operations or titration-type chemical reactions were

encouraging. Pyrolytic boron nitride and vitreous carbon underwent preliminary evaluation for use as materials in the equipment under development. Electrochemical cells were designed for recovering calcium from the salt used in the oxide reduction step. Calculations were made to estimate activity coefficients for plutonium in calcium-zinc alloys. 16 refs., 9 figs., 5 tabs.

33314 (WHC-SA–0426) **Model testing conducted to benchmark the Shippingport Reactor Pressure Vessel/Neutron Shield Tank safety analysis report for packaging.** Becker, D.L.; Bowen, W.W.; Burgess, D.M.; Goldmann, L.H. Westinghouse Hanford Co., Richland, WA (USA). Jun 1989. 20p. Sponsored by DOE Nuclear Energy. DOE Contract AC06-87RL10930. (CONF-890631–43: International symposium on packaging and transporting of radioactive materials, Washington, D.C., USA, 11-16 Jun 1989). Order Number DE89013529/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

One-tenth size concrete and steel models of the Shippingport Reactor Pressure Vessel/Neutron Shield Tank (RPV/NST) were subjected to free-drop tests as prescribed in the Code of Federal Regulations. Results of the tests provided materials physical and mechanical properties data and reaction rate information to support modeling assumptions and confirm analytical values used in the multidimensional dynamic analyses performed to ensure the structural integrity of the RPV/NST assembly during shipment from Pennsylvania to the Hanford Site in Richland, Washington for final disposal. 2 refs., 10 figs., 2 tabs.

33315 (WHC-SA–0570) **Hazardous material shipping computer-assisted training course.** Smith, L.J. Westinghouse Hanford Co., Richland, WA (USA). May 1989. 6p. Sponsored by DOE Defense Programs. DOE Contract AC06-87RL10930. (CONF-890631–42: International symposium on packaging and transporting of radioactive materials, Washington, D.C., USA, 11-16 Jun 1989). Order Number DE89013532/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The Hazardous Material Shipping Computer-Assisted Training Course (HAMSCAT) is a powerful training tool that can be integrated into existing training programs or become the core of a new program. The course combines an innovative Instructional System Design (ISD) with the flexibility and reliability of a personal computer. Designed to train personnel in the use of the most recent version of Title 49, code of Federal Regulations, Parts 171-173, the course teaches the process of using the regulations, rather than trying to teach the regulations themselves. 3 refs.

33316 (WSRC-RP–89-145) **Fluorination of incinerator ash by hydrofluorination or ammonium bifluoride fusion for plutonium recovery.** Fink, S.D.; Gray, J.H.; Kent, S.J.; Apgar, S.A. Westinghouse Savannah River Co., Aiken, SC (USA). 1989. 15p. Sponsored by DOE Defense Programs. DOE Contract AC09-89SR18035. (CONF-8905122–6-Vugraphs: 13. actinide separations conference, Idaho Falls, Idaho, USA, May 1989). Order Number DE89013772/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Incinerator ash containing small quantities of plutonium has been accumulating across the defense complex for many years. Although the total Pu inventory is small, the ash is a nondiscardable residue which presents storage and accountability difficulties. The work discussed here is the result of a joint exploratory effort between members of Savannah River Laboratory and Los Alamos National Laboratory to compare two proposed pyrochemical pretreatments of incinerator ash prior to aqueous processing. These experiments attempted to determine the relative effectiveness of hydrofluorination and ammonium bifluoride fusion as head-end operations for a two step aqueous recovery method. The two pretreatments are being considered as possible second generation enhancements for the New Special Recovery Facility nearing operation at Savannah River Plant. Experimental results and potential engineering concerns are discussed. 3 figs.

33317 **Clinoptilolite compositions in diagenetically-altered tuffs at a potential nuclear waste repository, Yucca Mountain, Nevada.** Broxton, D.E. (Los Alamos National Lab., NM (USA)). pp. 16 of Interface science and engineering '87. Hofmann, P.L. (ed.) Battelle Memorial Institute, Columbus, Ohio (1987).

The compositions of Yucca Mountain clinoptilolites and their host tuffs are highly variable. Clinoptilolites and heulandites in fractures near the repository and in a thin, altered zone at the top of the Topopah Spring basal vitrophyre have consistent calcium-rich compositions. Below this level, clinoptilolites in thick zones of diagenetic alteration on the east side of Yucca Mountain have calcic-potassic compositions and become more calcium rich with depth. Clinoptilolites in stratigraphically equivalent tuffs to the west have sodic-potassic compositions and become more sodic with depth. Clinoptilolite properties important for repository performance assessment include thermal expansion/contraction behavior, hydration/dehydration behavior, and ion-exchange properties. These properties can be significantly affected by clinoptilolite compositions. The compositional variations for clinoptilolites found by this study suggest that the properties will vary vertically and laterally at Yucca Mountain. Used in conjunction with experimental data, the clinoptilolite compositions presented here can be used to model the behavior of clinoptilolites in the repository environment and along transport pathways.

33318 **The effects of hydrogen on the metal barrier candidate materials for the nuclear waste management program.** Bullen, D.B. (Science and Engineering Associates, Inc., 5820 Stoneridge Mall Rd., Suite 100, Pleasanton, CA (US)); Gdowski, G.E.; McCright, R.D.; Halsey, W.G. v.v of Proceedings of the Electrochemical Society fall meeting. Volume 88-2 (extended abstracts). The Electrochemical Society, Pennington, NJ (1988). (CONF-881061–: Electrochemical Society fall meeting, Chicago, Illinois, USA, 9-14 Oct 1988).

The Nuclear Waste Management Program (NWMP) at Lawrence Livermore National Laboratory is responsible for the development of the waste package design to meet the Nuclear Regulatory Commission licensing requirements for the Nevada Nuclear Waste Storage Investigations Project (NNWSI). This waste will include spent fuel from civilian nuclear power plants PWR and BWR fuel assemblies, commercial high level waste (CHLW) in the form of borosilicate glass containing commercial spent fuel reprocessing wastes and defense high level waste (DHLW) contained in borosilicate glass. The waste package is being designed for emplacement in the unsaturated zone above the water table at the Yucca Mountain site in Nevada. This location should result in a slightly oxidizing repository environment. The Metal Barrier Selection and Testing Task is responsible for the selection of the materials to be employed in the waste package container. Six candidate materials are currently under consideration. These materials include three iron to nickel-based austenitic materials and three copper-based alloy materials. The austenitic materials are AISI 304L stainless steel. AISI 316L stainless steel and alloy 825. The copper-based alloy materials are CDA 102 (OFHC copper), CDA 613 (Cu-7Al) and CDA 715 (Cu-30Ni). The selection of the final metal barrier material is dependent upon the expected behavior of these materials in the repository environment.

33319 **Phase stability effects on the corrosion behavior of the metal barrier candidate materials for the nuclear waste management program.** Gdowski, G.E. (Science and Engineering Associates, Inc., 5820 Stoneridge Mall Rd., Suite 100, Pleasanton, CA (US)); Bullen, D.B.; McCright, R.D.; Halsey, W.C. v.v of Proceedings of the Electrochemical Society fall meeting. Volume 88-2 (extended abstracts). The Electrochemical Society, Pennington, NJ (1988). (CONF-881061–: Electrochemical Society fall meeting, Chicago, Illinois, USA, 9-14 Oct 1988).

Six candidate materials are currently under consideration by the Nuclear Waste Management Program (NWMP) at Lawrence Livermore National Laboratory as potential metal barrier materials for high-level nuclear waste storage. The waste package, which must meet the Nuclear Regulatory Commission licensing requirements for the Nevada Nuclear Waste Storage Investigations Project (NNWSI), will contain spent fuel from civilian nuclear power plants PWR and BWR fuel assemblies, commercial high level waste (CHLW) in the form of borosilicate glass containing commercial spent fuel reprocessing wastes and defense high level waste (DHLW) contained in borosilicate glass. The waste package is being designed for emplacement in the unsaturated zone above the water table at the Yucca Mountain site in Nevada. This location should result in a

slightly oxidizing repository environment. The Metal Barrier Selection and Testing Task is responsible for the selection of the materials to be employed in the waste package container. The candidate materials include three iron to nickel-based austenitic materials and three copper-based alloy materials. The austenitic materials are AISI 304L stainless steel, AISI 316L stainless steel and alloy 825. The copper-based alloy materials are CDA 102 (OFHC copper), CDA 613 (Cu-7Al) and CDA 715 (Cu-30Ni). The selection of the final metal barrier material is dependent upon the expected behavior of these materials in the repository environment.

33320 Mathematical models for redox and corrosion potentials for high level nuclear waste containers in tuff environments. Macdonald, D.D. (SRI International, Menlo Park, CA (US)); Urquidi-Macdonald, M. v.v of Proceedings of the Electrochemical Society fall meeting. Volume 88-2 (extended abstracts). The Electrochemical Society, Pennington, NJ (1988). (CONF-881061–: Electrochemical Society fall meeting, Chicago, Illinois, USA, 9-14 Oct 1988).

As part of the Nevada Nuclear Waste Storage Investigation Project, the authors have developed mixed potential models for predicting the environment redox potential and corrosion potentials for HLNW containers in tuff repositories. The models assume that the container is in contact with a thin aqueous layer on the surface, possibly present as a capillary condensate in the pores of a corrosion product film. This water layers is subject to n and γ radiolysis to produce electroactive species, such as H_2, O_2, H_2O_2, OH, O_2^-, HO_2^-, H, a_{aq}^-, H^+, and OH^- via a mechanism that involves 33 homogeneous reactions. Additionally, these nonequilibrium species are assumed to undergo charge transfer reactions at the metal surface in addition to the oxidation of the container material itself. These reactions take place such that the total current is zero; the mixed potential at which this occurs is termed the redox potential if the container is not corroded but is the corrosion potential when container oxidation is taken into account. The eleven coupled, nonlinear, second order partial differential equations that describe the transport, generation, and reaction of the radiolysis products within the film are solved numerically, with the additional constraints that the film must be electrically neutral at all points and that the temperature and n and γ intensities decay exponentially with time.

33321 CEUSP. McGinnis, C.P. (CEUSP Operations, Chemical Technology Div., Oak Ridge National Lab., Oak Ridge, TN (US)); Jacobus, R.A.; Bell, L.H. *Nuclear and Chemical Waste Management (USA),* 8(2): 115-122 (1988).

This article describes the technical, administrative, and regulatory problems overcome during a large-scale conversion and solidification of stored, highly radioactive, liquid waste at Oak Ridge National Laboratory. The radiochemical process used, the processing facility's design and construction, and the programmatic actions required to complete the project are discussed.

33322 A method for predicting cracking in waste glass canisters. Faletti, D.W. (Pacific Northwest Lab., Box 999, Richland, WA (US)); Ethridge, L.J. *Nuclear and Chemical Waste Management (USA),* 8(2): 123-134 (1988).

The radioactive liquid-fed ceramic melter technology is being implemented in the United States and abroad for the disposal of high-level radioactive wastes by vitrification. The resulting glass is poured into metal canisters. Thermal gradients develop as the glass cools; these cause the glass to crack, thereby increasing its surface area. Because this increased area could lead to greater release rates, estimates of the amount of cracking are useful. This paper presents a correlation that predicts the amount of surface area produced by cracking to within the limits of accuracy of all available experimental data. The data, obtained from this and five additional studies, are sparse. Therefore, further data, particularly for stainless steel canisters and for canisters lined with ceramic paper, will be required to confirm the validity of this correlation over all ranges of canister type and cooling conditions of interest. In addition, preliminary results indicate that the use of a ceramic paper between the glass and the canister greatly reduces the amount of fine particle produced and also reduces the amount of surface area produced.

33323 Mathematical modeling of large-scale nonuniform corrosion. Walton, J.C. (Idaho National Engineering Lab., P.O. Box 1625, Idaho Falls, ID (US)). *Nuclear and Chemical Waste Management (USA),* 8(2): 143-156 (1988).

Understanding of container corrosion is fundamental to long term isolation of nuclear waste. One aspect of corrosion which is difficult to examine experimentally is the formation of large scale corrosion cells. Initiation of the phenomenon in environments where diffusional transport dominates requires very long time periods, generally longer than experimental time frames. A mathematical model is developed to evaluate formation of large scale corrosion cells surrounding steel containers. The model includes transport of nine species by diffusion and electromigration with simultaneous chemical reaction. The model can be applied in partially or fully water saturated environments. The governing equations are first examined in dimensionless format to illustrate some of the important factors controlling cell strength. Numerical solutions to two general classes of problem are examined (a) differential aeration, and (b) spatial variation in passivation current. The focus is on whether predicted changes in solution composition attributable to the cells are large enough to significantly impact further corrosion and/or radionuclide release rate subsequent to localized container breach. The analysis suggests that large scale cells are likely to be an important factor in waste isolation.

33324 US programs in the development of spent fuel and high-level waste disposal technology. Rusche, B.C. *Transactions of the American Nuclear Society (USA),* 56(1): 567-571 (1988). (CONF-870905–: 6. Pacific Basin nuclear conference, Beijing, China, 7-11 Sep 1987).

The Nuclear Waste Policy Act directs the US Department of Energy to establish a program for the siting of two geologic repositories and to develop other components of a waste management system. Policy goals and program objectives related to the Act are discussed. The paper presents a summary of programmatic achievements, both technical and institutional. Technical achievements include application of systems analysis to program planning, development of transportation casks, data management for repository siting, and dry storage and rod consolidation. Remaining challenges and the role of international cooperation in meeting these challenges are also discussed.

0530 Environmental Aspects

Refer also to citation(s) 33221, 33254, 33255, 33256, 33257, 33258, 33263, 33264, 33277, 33278, 33279, 33280, 33281, 33286, 33288, 33289, 33290, 33291, 33292, 33293, 33294, 33295, 33296, 33297, 33298, 33299, 33300, 33301, 33302, 33303, 33304, 33305, 33306, 33307, 33312, 33314, 33315, 33320, 33323, 34131, 34132, 34136, 34506

33325 (IAEA-TECDOC–492, pp. 97-126) **Groundwater restoration and stabilization at the Ruth-ISL test site in Wyoming, USA.** Schmidt, C. (Uranerzbergbau G.m.b.H. und Co. K.G., Bonn (Germany, F.R.)). International Atomic Energy Agency, Vienna (Austria). Jan 1989. (CONF-8711306–: Technical committee meeting on in situ leaching of uranium: Technical, environmental and economic aspects, Vienna, Austria, 3-6 Nov 1987). In *In situ leaching of uranium: Technical, environmental and economic aspects. Proceedings of a technical committee meeting held in Vienna, 3-6 November 1987.* Order Number DE89617917/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

The paper describes operations of restoration and stabilization of the Ruth Site in Wyoming, USA. The Ruth orebody, listed by tertiary sediments, exploitation was started in 1981 as a pilot test before construction of a commercial production facility. The several phases of the pilot test are described: licensing and pre-operational base lining; leach test; ground water restoration and stabilization. (author). 20 figs, 5 tabs.

33326 Excursion control at in situ uranium mines. Staub, W.P. (Oak Ridge National Lab., Oak Ridge, TN (US)). v.v of Geotechnical and geohydrological aspects of waste management. VanZyl, D.J.A.; Nelson, J.D.; Abt, S.R.; Shepherd, T.A. Lewis Publishers, Chelsea, MI (1986). (CONF-870211–: 9. annual symposium on geotechnical and geohydrological aspects of waste management, Ft. Collins, Colorado, USA, 2-6 Feb 1987).

Intensive research and development of in situ uranium mining took place in the United States during the 1970's. By the end of the decade, nearly 10% of all uranium production came from in situ mines. Recent poor market conditions, however, forced the closure of all domestic in situ uranium mines. When market conditions improve, domestic in situ mining is expected to make a modest recovery. Successful licensing of future in situ mines depends to a large extend on the ability to contain the leach solutions (lixiviant) within the ore zone. Uncontrolled movement of lixiviant beyond the ore zone is called an excursion. Early detection of an excursion is a necessary prelude to the implementation of timely corrective action to return escaping fluid to the well-field. Without timely corrective action, a large quantity of valuable production fluid may be irretrievably lost and serious contamination of adjacent groundwater resources may result. Two types of excursion are recognized: horizontal and vertical. In horizontal excursions lixiviant remains strata bound but migrates laterally away from the production well-field. In vertical excursions lixiviant escapes into aquifers above or below the ore bearing strata.

33327 **Methodology for oversizing marginal quality riprap for erosion control at uranium mill tailings sites.** Staub, W.P. (Oak Ridge National Lab., Oak Ridge, TN (US)); Abt, S.R. v.v of Geotechnical and geohydrological aspects of waste management. VanZyl, D.J.A.; Nelson, J.D.; Abt, S.R.; Shepherd, T.A. Lewis Publishers, Chelsea, MI (1986). (CONF-870211–: 9. annual symposium on geotechnical and geohydrological aspects of waste management, Ft. Collins, Colorado, USA, 2-6 Feb 1987).

Properly selected and oversized local sources of riprap may provide superior erosion protection compared with revegetation at a number of uranium mill tailings sites in arid regions of the United States. Whereas highly durable rock is appropriate for protecting diversion channels to the height of the 5-year flood, marginal quality rock may be adequate for protecting infrequently flooded side slopes of diversion channels, tailings embankments and caps. Marginal quality rock may require oversizing to guarantee that design size specifications are met at the end of the performance period (200 to 1000 years). This paper discusses a methodology for oversizing marginal quality rock. Results of cyclic freezing and thawing tests are used to determine oversizing requirements as functions of the performance period and environment.

0540 Health and Safety

Refer also to citation(s) 34438, 34675, 35198

33328 (DOE/OR/21548–046-Rev.1) **Radiological and chemical characterization report for the planned Quarry Construction Staging Area and Water Treatment Plant: Revision 1.** MK-Ferguson Co., St. Charles, MO (USA); Jacobs Engineering Group, Inc., St. Charles, MO (USA). Mar 1989. 51p. Sponsored by DOE Nuclear Energy. DOE Contract AC05-86OR21548. Order Number DE89014623/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

The Quarry Construction Staging Area and Water Treatment Plant (QCSA) will be used in the support of the bulk waste removal of the Weldon Spring Quarry. Radiological and chemical characterization was performed on a 12 acre site where the QCSA will be constructed. The characterization revealed approximately .5 acres of radiologically contaminated land. No chemical contamination was found. 8 refs., 5 figs., 7 tabs.

33329 (INIS-mf–11457(v.1,2)) **Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).** Stocker, H. (ed.). Canadian Nuclear Association, Toronto, ON (Canada). 1985. 704p. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

The first International Conference on Occupational Radiation Safety in Mining was held three years ago in Golden, Colorado, U.S.A., and it provided an excellent forum for an exchange of information on the many scientific, technical and operational aspects of radiation safety in mining. I am aware of the broad spectrum of epidemiological, engineering and related studies which have been pursued during the past three years with a view to achieving further improvements in radiation protection and I expect that the information on these studies will contribute significantly to a wider understanding of subject, and in particular, the means by which radiation safety measures in mining can be optimized.

0550 Safeguards, Inspection, and Accountability

Refer also to citation(s) 33228, 35472

33330 (LA–11615-MS) **Near-real-time verification approaches for the process area of reprocessing plants.** Hakkila, E.A.; Barnes, J.W.; Gutmacher, R.G.; Picard, R.R. Los Alamos National Lab., NM (USA). Jun 1989. 35p. Sponsored by DOE Defense Programs. DOE Contract W-7405-ENG-36. Order Number DE89013338/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Near-real-time accounting is being considered as a technique for improving accounting timeliness in reprocessing plants. A major criticism of near-real-time accounting is perceived disclosure of proprietary data for International Atomic Energy Agency verification, particularly in verifying the inventory of solvent extraction contractors. This study indicated that the contribution of uncertainties in estimating the inventory of pulsed columns or mixer settlers may be significant compared with uncertainties in measured throughput and measurable inventory for most reprocessing plants; thus, verification may not be a serious problem. Verification can become a problem for plants with low throughput and low inventory in process tanks if contractor inventory variations or uncertainties are greater than ~25%. Each facility must be evaluated with respect to its specific inventory throughput characteristics. 49 refs., 4 figs., 4 tabs.

33331 (LA-UR–89-1715) **Near-real-time verification approaches for the process area of reprocessing plants.** Hakkila, E.A.; Barnes, J.W.; Picard, R.R.; Gutmacher, R.G. Los Alamos National Lab., NM (USA). 1989. 7p. Sponsored by DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-890565–4: 11. annual ESARDA symposium on safeguards and nuclear materials management, , Luxembourg, 30 May - 1 jun 1989). Order Number DE89013440/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Adoption of near-real-time accountancy in large reprocessing plants will necessitate more timely verification. We discuss techniques and instruments that are suitable for on-site verification of input, output, waste streams, and in-process inventory estimation of tanks, solvent extraction contractors, and concentrators. Calculations show that estimates of solvent extraction contractor inventories may make an insignificant contribution to the total uncertainty of the material balance, relative to the contributions by transfer and process tank inventory measurements. 45 refs., 2 tabs.

33332 (LA-UR–89-1776) **Randomization of inspections.** Markin, J.T. Los Alamos National Lab., NM (USA). 1989. 21p. Sponsored by DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-890565–5: 11. annual ESARDA symposium on safeguards and nuclear materials management, , Luxembourg, 30 May - 1 jun 1989). Order Number DE89013459/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

As the numbers and complexity of nuclear facilities increase, limitations on resources for international safeguards may restrict attainment of safeguards goals. One option for improving the efficiency of limited resources is to expand the current inspection regime to include random allocation of the amount and frequency of inspection effort to material strata or to facilities. This paper identifies the changes in safeguards policy, administrative procedures, and operational procedures that would be necessary to accommodate randomized inspections and identifies those situations where randomization can improve inspection efficiency and those situations where the current nonrandom inspections should be maintained. 9 refs., 1 tab.

33333 (LA-UR–89-1862) **Poor man's densitometry.** Hsue, S.-T.; Zhu, R. Los Alamos National Lab., NM (USA). 1989. 9p. Sponsored by DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-890736–1: 30. annual meeting of the Institute of Nuclear Materials Management, Orlando, Florida, USA, 9-12 Jul

1989). Order Number DE89013465/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We have developed two novel methods of determining plutonium concentrations (and isotopic distribution) that require no external radioactivity sources or x-ray generators but rely only on the natural radiation from the plutonium. The methods are ideally suited to assay reasonably pure plutonium solutions, such as product solutions of reprocessing plants and eluate solutions from anion exchange columns. The methods can be applied to aged or freshly separated plutonium and can be used to measure plutonium concentrations in pipes or tanks. Because these methods do not require expensive equipment we call them "Poor Man's Densitometry." 9 refs., 15 figs.

33334 (SAND–89-1114C) **Development and integration of a material monitoring/tracking system at ANL.** Roybal, J.A.; Garcia, B.A.; Henslee, S.P.; Jackson, B.G. Sandia National Labs., Albuquerque, NM (USA); Argonne National Lab., Idaho Falls, ID (USA). 1989. 3p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789;W-31109-ENG-38. (CONF-890736–5: 30. annual meeting of the Institute of Nuclear Materials Management, Orlando, Florida, USA, 9-12 Jul 1989). Order Number DE89014745/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A Personnel and Material Tracking System (PMTS) demonstrated at Argonne National Laboratories-West (ANL-W) in 1987 has resulted in the further development of this system. The results of the demonstration indicated immediate potential for the Material Monitoring/Tracking (MM) portion of the system. The MM system provides the separate functions of (1) observing all container movements, (2) authorized access approval,and (3) initiation and receipt of material transfers. All three functions are coordinated through a single computer which is known as the Computer Augmented Material Access (CAMA) computer. The Wireless Alarm Transmission of Container handling (WATCH) system provides Function 1, and the Mobile Accountability Verification Inventory Station (MAVIS) system provides Functions 2 and 3. Faster communications and the expanded and refined software package developed to provide Functions 2 and 3 stands out as the major accomplishment of this project. Increased functionality with enhanced protection against the insider threat in a more friendly operator interface is provided by this software. 3 refs., 2 figs.

33335 (SAND–89-1602C) **The ASSESS outsider analysis module.** Winblad, A.; Snell, M.; Jordan, S.E.; Key, B.; Bingham, B.; Walker, S. Sandia National Labs., Albuquerque, NM (USA). 1989. 6p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890736–9: 30. annual meeting of the Institute of Nuclear Materials Management, Orlando, Florida, USA, 9-12 Jul 1989). Order Number DE89014800/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The Outsider Analysis (Outsider) module is part of the Analytic System and Software for Evaluating Safeguards and Security (ASSESS). Outsider and the ASSESS Facility Descriptor (Facility) module together supersede the Systematic Analysis of Vulnerability to Intrusion (SAVI) software package. Outsider calculates P(I), the probability that outsiders are interrupted during an attack by security forces at the facility, and P(W), the probability of security system win, and has other features not found in SAVI. Analysts can select intruders from a set of ten reference threats, ranging from well-equipped terrorists to intruders with no equipment at all. New analysis algorithms run 60 to more than 100 times faster. New reports detail how safeguards are defeated at each element in a path and give other data critical to effective upgrade decisions. Outsider takes as input a facility security system defined in Facility and produces intermediate results for the ASSESS Collision module. 8 refs., 6 figs.

33336 On-line diagnosis and recovery of adversary attack using logic flowgraph methodology simulation. Guarro, S.B. (Lawrence Livermore National Lab., P.O. Box 808, L-196, Livermore, CA (US)). v.v of Simulators III. Fairchild, B.T. Society for Computer Simulation, San Diego, CA (1986). (CONF-860359–: Eastern simulation conference, Norfolk, Virginia, USA, 10-12 Mar 1986).

The Logic Flowgraph Methodology (LFM) allows the construction of special graph models for simulation of complex processes of causality, including feedback loops and sequential effects. Among the most notable features of LFM is the formal inclusion in its models of causality conditioning by logic switches imbedded in the modeled process, such as faults or modes of operation. The LFM model of a process is a graph structure that captures, in one synthetic representation, the relevant success and fault space characterization of that process. LFM is very similar to an artificial intelligence expert system shell. To illustrate the utilization of LFM, an application to the assessment and on-line monitoring of a material control facility is presented. The LFM models are used to model adversary action and control response, and to generate mini-diagnostic and recovery trees in real time, as well as reliability tress for off-line evaluation. Although the case study presented is for an imaginary facility, most of the conceptual elements that would be present in a real application have been retained in order to highlight the features and capabilities of the methodology.

33337 The Academies' review of material control and accounting. Kouts, H.J.C. (Brookhaven National Lab., Upton, NY (US)). *Nuclear Materials Management. Annual Meeting Proceedings (USA),* 17: 36-40 (1988). (CONF-880631–: 29. annual meeting of the Institute of Nuclear Materials Management, Las Vegas, Nevada, USA, 26-29 Jun 1988).

A Committee appointed by the National Academies of Engineering and Sciences has conducted a review of the system of Material Control and Accounting used in facilities of the Department of Energy. The report on this review, containing conclusions and recommendations, is now being prepared. In this paper the authors give a view of the topics considered by the Committee in preparing its report.

0560 Legislation and Regulations

Refer also to citation(s) 33321, 34694

33338 (OEVS-Mitteilung–1988, pp. 81-85) **Licensing procedure for X-ray equipment in 1899.** Tschurlovits, M. (Atominstitut der Oesterreichischen Universitaeten, Vienna (Austria)); Karacson, P. Oesterreichischer Verband fuer Strahlenschutz (OeVS), Vienna (Austria). Nov 1988. (In German). (CONF-860969–: 4. European congress and 13. regional congress of the International Radiation Protection Association, Salzburg, Austria, 15-19 Sep 1986). In *4. European congress and 13. regional congress of IRPA. 20 years experience in radiation protection - a review and outlook.* Order Number DE89613806/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

Several examples from two licensing procedures for X-ray equipment in Austria in 1899 are shown. Scientific and administrative aspects are considered. 3 refs., 3 figs.

07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY

0702 Radiation Sources

Refer also to citation(s) 33564, 33779, 35127

33339 (JAERI-M–88-248) **Studies on applications of functional organic-thin-films for lithography on semiconductor device production.** Ogawa, Kazufumi. Japan Atomic Energy Research Inst., Tokyo (Japan). Dec 1988. 185p. (In Japanese). Order Number DE89778127/JAW. Available from NTIS (US Sales Only), PC A09/MF A01.

This report describes some experimental results of studies in an attempt to contribute to the development of ultra-fine lithography which is used for the manufacture of semiconductor devices with design rule below 0.5 μm, and contains (1) manufacture of the exposure apparatus, (2) establishment of the resist process technology, and (3) preparation of the resist materials. The author designed and manufactured the KrF excimer laser stepper which is supposed to be most promising for practical uses. In the resist processing technology, the water-soluble contrast enhanced lithography (CEL) process was developed and this process has advantages is that high pattern contrast and large focus depth latitude were easily

obtained. Finally, for resist materials, use of Langmuir-Blodgett (LB) films was investigated since the LB technique provides the method to prepare extremely thin organic films which are uniform in molecular level, and the reaction mechanism of the LB films of unsaturated compounds under irradiation with high energy beams was elucidated.

08 HYDROGEN

0801 Production

Refer also to citation(s) 33040, 33705

33340 (CONF-8810170–, pp. 142-159) **Hydrogen from coal gasification: hope for improved economics.** Bauer, F. (Morgantown Energy Technology Center, WV (USA)). USDOE Pittsburgh Energy Technology Center, PA (USA). 1988. From DOE direct liquefaction contractor's conference; Pittsburgh, Pennsylvania, USA; 4-6 Oct 1988. In *Direct liquefaction contractors' review meeting. Proceedings.* Order Number DE89009225/JAW. Available from NTIS, PC A22/MF A01; 1.

The Department of Energy at the Morgantown Energy Technology Center hopes to reduce the cost of producing hydrogen from coal by supporting development of technologies which focus on improved feedstock reactivity and by improved gas separation by solvents and membranes. The University of North Dakota Energy and Minerals Research Center is exploiting the inherent high reactivity of low-rank coal char in a fluid bed system. The steam gasification rate of low-rank coal is about an order of magnitude higher than that from a bituminous coal. This increase is caused by a higher concentration of active sites, higher porosity, and a uniform dispersion of alkali impurities which serve as catalysts. The National Institute for Standards and Technology is exploiting a facilitated transport of acid gas impurities such as hydrogen sulfide and carbon dioxide through a thin membrane to purify hydrogen. The hydrogen stream in this work needs to have most of the carbon monoxide converted to carbon dioxide by the water gas shift reaction. Membrane Technology and Research, Inc. intends to use poly(ether-imide) to separate hydrogen from nitrogen and from carbon monoxide. They plan to separate the acid gases, hydrogen sulfide and carbon dioxide from hydrogen with poly(ether-ester-amide). The City College of New York hopes to separate hydrogen from the other components of raw syngas by exploiting the properties of solvent pairs. Mixtures of solvents near their critical point of miscibility exhibit strongly improved solvent properties which may be the key to improved extraction processes. The status of these four programs are reviewed.

33341 (DOE/MC/23287–2657) **A novel approach to hydrogen recovery, storage and transport: Final technical report.** Fowler, M.C.; Sangiovanni, J.J. United Technologies Research Center, East Hartford, CT (USA). Dec 1988. 62p. Sponsored by DOE Fossil Energy. DOE Contract AC21-87MC23287. Order Number DE89000932/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

The obtaining of high purity hydrogen from the coal gasification process is a series of chemical reactions, several of which require preparation/purification. At any point in the process, it would be useful to have a chemical separation system which can purify the product hydrogen and store it in convenient form. The purpose of this research program is to evaluate one such candidate system, the catalytically reversible hydrogenation of an aromatic hydrocarbon, toluene, to its corresponding cyclical paraffin, methylcyclohexane. In this reaction scheme, the hydrogen present in the product flow from, in principle, any reaction in the coal gasification process is extracted from the flow by reaction with toluene, a readily transportable liquid at ambient temperatures, to form methylcyclohexane, MCH, which is also a liquid at ambient conditions. The hydrogen stored in the organic hydride could therefore be transported and released when desired in the reverse reaction to give recoverable toluene and the desired hydrogen. 13 refs., 30 figs., 22 tabs.

0802 Storage

33342 **The effects of current density and recombination poisons on electrochemical charging of deuterium into austenite.** Robinson, S.L. (Sandia National Labs., Livermore, CA 94550, Albuquerque, NM (US)); Moody, N.R.; Myers, S.M.; Farmer, J.C.; Greulich, F.A. v.v of Proceedings of the Electrochemical Society Fall meeting: Extended abstracts. Volume 87-2. The Electrochemical Society, Pennington, NJ (1987). (CONF-871027–: 172. meeting of the Electrochemical Society, Honolulu, Hawaii, USA, 18-23 Oct 1987).

The study of hydrogen embrittlement in metals and alloys often requires room temperature charging of hydrogen into the metal. Electrochemical charging, often conducted at a constant current density, is the easiest and most common method of hydrogen charging at room temperature. In addition, a recombination poison is often added to insure hydrogen absorption. However, the effects of the recombination poison and the relationship between the charging current density and hydrogen concentration in metals is not well defined. This study compares the effects of poisoned and non-poisoned solutions over a wide range of current density. Deuterium was substituted for hydrogen, and near-surface deuterium concentrations were measured by nuclear reaction analysis (NRA) techniques.

0808 Properties

Refer also to citation(s) 33205

33343 **Hydrogen-air-diluent detonations.** Stamps, D.W. (Sandia Nat. Labs., Albuquerque, NM (US)); Tieszen, S.R. v.v of The Combustion Institute joint conference: Western states and Japanese sections (Extended Abstracts). Combustion Institute, Pittsburgh, PA (1988). (CONF-871118–: Combustion Institute joint fall meeting: Western states and Japanese sections, Honolulu, Hawaii, USA, 22-25 Nov 1987).

The effect of initial pressure and initial temperature on the detonation cell width, λ, is addressed theoretically and in part experimentally for hydrogen-air-diluent mixtures. Results show a local minimum in λ as a function of initial pressure and decreasing λ with increasing initial temperature for hydrogen-air mixtures diluted with either steam or carbon dioxides.

33344 **Flame acceleration and transition to detonation in channels.** Sherman, M.P. (Sandia Nat. Labs., Livermore, CA (US)); Tieszen, S.R.; Benedick, W.B. v.v of The Combustion Institute joint conference: Western states and Japanese sections (Extended Abstracts). Combustion Institute, Pittsburgh, PA (1988). (CONF-871118–: Combustion Institute joint fall meeting: Western states and Japanese sections, Honolulu, Hawaii, USA, 22-25 Nov 1987).

Experimental results are reported for combustion of pre-mixed H_2-air mixtures in a 136 m^3 channel and a 1:12.6 linear scale model. Test variables include H_2-air equivalence ratio, obstacles and degree of transverse venting. The results show that flame acceleration is increased by sensitive mixtures, presence of obstacles, large scales, and insufficient venting. The results also support the hypothesis that deflagration to detonation transition (DDT) can occur if the ratio of detonation cell width to channel width is less than a critical value, provided that the flame speed prior to transition has approached the isobaric sound speed.

09 OTHER SYNTHETIC AND NATURAL FUELS

0901 Hydrocarbon Fuels

Refer also to citation(s) 33087, 33114, 33383, 33385, 33980, 34047, 34069, 34520

33345 (ARC–1989, pp. 6) **Speculation on molecular environment of reactive hydrogen atoms in coal.** Gawlak, M. (Alberta Research Council, Edmonton.); Cyr, N.; Carson, D.; Ignasiak, B. Alberta Research Council, Edmonton, AB (Canada). [1989]. (CE–02438). In *Alberta Research Council [research reports].* Available from CANMET/TID, Energy, Mines and Resources Canada, 555

Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages.

The work on the solubilization of coal by non-reductive ethylation in liquid ammonia has shown that, in the samples studied, 8 to 13 hydrogen atoms per 100 carbon atoms are acidic enough to form alkali metal salts with sodium and potassium amides. Ethyl derivatives of these salts impart to the coals treated a fractional, but greatly increased solubility in chloroform. Duplications of the reaction conditions with model compounds (adamantane, indan, 1,2-diphenylethane, diphenylmethane, 9,10-dihydrophenanthrene, 9,10-dihydroanthracene and fluorene) has shown that hydrogen atoms in the polycondensed cyclic network of adamantane are unreactive. The same is true for methylene groups of indan. The methylene bridge is more reactive than the open ethylene bridge; both exhibit greatly increased reactivities when they become a part of a hydroaromatic system. Approximately 60 per cent of hydrogen, which is replaced on ethylation, substitutes easily; the remaining 40 per cent is more difficult to replace. Evidence suggests that reluctant substitution is the substitution on the ethylene bridge of the type found in 9,10-dihydrophenanthrene. 10 refs., 2 figs., 2 tabs.

33346 (ARC–1989, pp. 16) **Liquefaction characteristics of Alberta subbituminous coals.** duPlessis, M.P. (Alberta Research Council, Edmonton); Gawlak, M.; Moschopedis, S.; Parkash, S.; Lewkowicz, L.; Ignasiak, B. Alberta Research Council, Edmonton, AB (Canada). [1989]. (CE–02438). In *Alberta Research Council [research reports].* Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages.

Batch autoclave liquefaction tests were conducted with three reference coals (subbituminous ranks A, B and C respectively) under five typical liquefaction process conditions. The variables investigated to date are catalyst type and concentration, coal-derived solvents, gases (hydrogen, carbon monoxide and steam mixtures), heating rate, reaction time and temperature. The results indicate that there are significant differences in coal reactivities, depending on the liquefaction technique used. Promising combinations of liquefaction techniques for the optimum conversion of Alberta coals to liquid products are identified. 7 refs., 1 fig., 6 tabs.

33347 (ARC–1989, pp. 7) **Comparative studies on the liquefaction and solubilization reactivity of subbituminous and bituminous coals.** Ignasiak, B. (Alberta Research Council, Edmonton); duPlessis, M.P.; Gawlak, M.; Carson, D. Alberta Research Council, Edmonton, AB (Canada). [1989]. (CE–02438). In *Alberta Research Council [research reports].* Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages.

Alberta's deposits of subbituminous coal represents a large potential source of liquid fuels. This communication describes some of the work on the solubilization and liquefaction of selected Alberta coals carried out at the Alberta Research Council. The principles of coal solubilization through reductive and non-reductive alkylation in liquid ammonia are summarized, and the results of studies on some aspects of the coal liquefaction mechanism, using the non-destructively alkylated (soluble) coals as a model, are discussed. The results of some autoclave liquefaction tests conducted with different coals, under conditions that seem to be particularly promising for indigenous coals, are also presented. The results show marked differences in conversion yields among different coal deposits, thus emphasizing the need to optimize liquefaction conditions for individual coal regions. Selected results showing the effect of solvent type and coal maceral content are presented. Possible means of reducing hydrogen consumption for the substantial amounts of water generated during hydroliquefaction of Alberta's high oxygen coals are discussed. 13 refs., 8 figs., 1 tab.

33348 (ARC–1989, pp. 3) **Use of synthesis gas in co-processing of coal-bitumen and derivatives.** Moschopedis, S.E. (Alberta Research Council, Edmonton); Hawkins, R.W. Alberta Research Council, Edmonton, AB (Canada). [1989]. (CE–02438). In *Alberta Research Council [research reports].* Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages.

Heavy oil and liquid derivatives from oil sands bitumen have been reported as potential low-cost hydrogen donor solvents to solubilize high-volatile C bituminous coal. The cost of the hydrogen needed to convert coal to liquid fuels can be further reduced by using synthesis gas (H_2 + CO) instead of hydrogen. Bitumen, heavy oils and related liquids can solubilize part of a coal when H_2 + CO is employed, but that the conversion yields are lower than when H_2 is employed; nevertheless, the extent of coal solubilization varies and is dependent upon the type of solvent and the conditions of the reaction. 3 refs., 1 fig., 3 tabs.

33349 (DOE/PC/80015–T4) **Performance testing with a gas-liquid-solid system in a mechanically-stirred reactor: The Fischer-Tropsch synthesis.** Donnelly, T.J.; Satterfield, C.N. Massachusetts Inst. of Tech., Cambridge, MA (USA). Dept. of Chemical Engineering. 1987. 46p. Sponsored by DOE Fossil Energy. DOE Contract AC22-85PC80015. Order Number DE89013680/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Careful attention to reactor operating procedures and methods of product trapping and analysis is required to obtain accurate and reliable data on selectivity and kinetics when a wide variety of products are formed. Useful methods are discussed in detail. The focus of attention is on use of iron-based Fischer-Tropsch catalysts studied in a well-mixed slurry reactor, but many of the findings apply to other catalysts and reactor systems used for Fischer-Tropsch synthesis or to other reactions in which a complex mixture of products is formed. Some apparent discrepancies in the literature regarding catalyst activity and selectivity in Fischer-Tropsch synthesis are explained by analysis of the pertinent experimental systems. 50 refs., 4 figs., 2 tabs.

33350 (IAEA-TECDOC–486) **Radiation technology for immobilization of bioactive materials. Proceedings of the final research co-ordination meeting held in Beijing, 15-18 June 1987.** International Atomic Energy Agency, Vienna (Austria). Dec 1988. 172p. (CONF-8706397–: Final research co-ordination meeting on application of radiation technology in immobilization of bioactive materials, Beijing, China, 15-18 Jun 1987). Order Number DE89617908/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

Within the framework of the Agency's coordinated research programme on "Application of Radiation Technology in Immobilization of Bioactive Materials", the third and final research coordination meeting was held at Beijing University, Beijing, People's Republic of China, 15-18 June 1987. The present publication compiles all presentations made at the meeting. Fundamental processes for the immobilization of enzymes, antibodies, cells and drugs were developed and established using gamma radiation, electron beams and plasma discharge. Applications of various biofunctional components, immobilized by radiation techniques in different processes, were studied. A range of backbone polymers has been examined together with various monomers. Coupling procedures have been developed which are relevant to our particular requirements. Enzymes of various types and characteristics have been immobilized with considerable efficiency. The immobilized biocatalysts have been shown to possess significant activity and retention of activity on storage. There appears to be a high degree of specificity associated with the properties of the immobilised biocatalysts, their activity and the ease of their preparation. Novel additives which lower the total radiation dose in grafting have been discovered and their value in immobilization processes assessed. Potential applications include: medical (diagnostic, therapeutic), and industrial processes (fermentation, bioseparation, etc.). Refs, figs and tabs.

33351 (IAEA-TECDOC–486, pp. 7-24) **Additive effects in UV and radiation grafting and curing processes of value in immobilization of bioactive materials.** Dworjanyn, P.A. (New South Wales Univ., Kensington (Australia). School of Chemistry); Garnett, J.L.; Jankiewicz, S.V.; Sangster, D.F. International Atomic Energy Agency, Vienna (Austria). Dec 1988. (CONF-8706397–: Final research co-ordination meeting on application of radiation technology in immobilization of bioactive materials, Beijing, China, 15-18 Jun 1987). In *Radiation technology for immobilization of bioactive materials. Proceedings of the final research co-ordination meeting held in Beijing, 15-18 June 1987.* Order Number DE89617908/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

The scope of UV and ionizing radiation grafting techniques for the immobilization of bioactive materials is discussed. The principle of the method is outlined. This involves copolymerization of a monomer containing an appropriate functional group to a backbone polymer, then attachment of the reagent by subsequent chemical reactions. Novel additives which lower the total radiation dose in grafting have been discovered and their value in immobilization processes assessed. A theory for this additive effect in grafting is proposed. Methods for speeding up these radiation processes for immobilization involving sensitized UV and electron beam (EB) curing reactions are considered. The advantages of the curing technique for immobilization are summarized. Examples of typical enzymes immobilized by the above radiation processes are given. (author). 23 refs, 11 tabs.

33352 (IAEA-TECDOC–486, pp. 69-93) **Immobilization of biocatalysts onto copolymeric assemblies - Role of radiation induced copolymerisation.** Beddows, C.G. (Leeds Univ. (UK). Dept. of Colour Chemistry); Bilgin, V.; Gil, M.H.; Green, J.; Guthrie, J.T.; Kotov, S.; Morris, R.; Resendez, D. International Atomic Energy Agency, Vienna (Austria). Dec 1988. (CONF-8706397–: Final research co-ordination meeting on application of radiation technology in immobilization of bioactive materials, Beijing, China, 15-18 Jun 1987). In *Radiation technology for immobilization of bioactive materials. Proceedings of the final research co-ordination meeting held in Beijing, 15-18 June 1987.* Order Number DE89617908/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

This report contains a review of our recent work as seen from two aspects. The first is based on radiation processing aspects while the second considers the assemblies from the biotechnological standpoint. The approach taken in our studies involves process optimisation, the development of a hydrophilic/hydrophobic balance, copolymer characterisation procedures, morphology rationalisation and appreciation of activation/preferential adsorption effects. A range of backbone polymers has been examined together with various monomers (present singly or in mixtures). Coupling procedures have been developed which are relevant to our particular requirements. Enzymes of various types and characteristics have been immobilised with considerable efficiency. The immobilised biocatalysts have been shown to possess significant activity and retention of activity on storage. There appears to be a high degree of specificity associated with the properties of the immobilised biocatalysts, their activity and the ease of their preparation. The role of the continuous medium at various stages in immobilisation, storage and application appears to present a dominance which is in need of rationalisation. (author). 48 refs, 4 figs, 14 tabs.

33353 (PB–89-148928/XAB) **Nature of methane activation over oxide centers. Annual report, September 1987-September 1988.** Marcelin, G.; Agarwal, S.K.; Migone, R.A. Pittsburgh Univ., PA (USA). Dept. of Chemical Engineering. Oct 1988. 71p. Available from NTIS, PC A04/MF A01.

See also PB–88-159918.

The oxidative coupling of methane was studied over alkali-promoted antimony oxide and lead-magnesia catalysts. Reaction studies were used in conjunction with bulk and surface characterization of the catalysts to attempt to characterize the active centers. It was found that both acidity and availability of strong oxidizing sites can influence the selectivities of the various products of the reaction.

33354 Alternative energy in the Midwest. vp.Illinois Dept. of Energy and Natural Resources, Springfield, IL (1987). (CONF-870366–: Alternative energy in the midwest: research and applications, Rosemont, Illinois, USA, 18-20 Mar 1987).

Technical Paper ILENR/AE-87/6.

These proceedings collect papers on alternate energy. Topics include: waste-to-energy systems; wind energy; photovoltaics; hybrid solar conversion; alcohol as an automotive fuel; solar ponds; bimomass; and project development and financing.

33355 Pyrolysis of municipal solid waste. Helt, J.E. (Alternative Energy in the Midwest, Research and Applications, Rosemont, IL (US)); Agrawal, R.K.; Mallya, N. v.v of Alternative energy in the Midwest. Illinois Dept. of Energy and Natural Resources, Springfield, IL (1987). (CONF-870366–: Alternative energy in the midwest: research and applications, Rosemont, Illinois, USA, 18-20 Mar 1987).

Technical Paper ILENR/AE-87/6.

The pyrolysis of municipal solid waste (MSW) is a potential method of producing useful fuels. However, past attempts to utilize the technology have resulted in facilities that have not performed as expected, producing low yields of inferior products. Background on past pyrolytic concepts and the current status of the technology are discussed. Most MSW is cellulosic in nature, comprising paper, newsprint, packaging materials, wood wastes, and yard clippings. The end products of MSW pyrolysis are: a highly carbonaceous solid char, a highly oxygenated liquid tar, and a mixture of gases with low to medium BTU content. Current DOE/ANL research has been undertaken to gain a better understanding of the basic mechanisms, kinetics, and chemistry involved in the pyrolytic conversion of MSW and its components. The objectives of this program, current research efforts, results to date, and future plans are discussed.

33356 Characterization of polysaccharidase activity optima in the anaerobic digestion of municipal solid waste. Adney, W.S. (Solar Energy Research Inst., Golden, CO (USA)); Rivard, C.J.; Grohmann, K.; Himmel, M.E. *Biotechnology Letters (UK)*, 11(3): 207-210 (1989).

Cellulolytic enzymes from a laboratory anaerobic digester fed municipal solid waste were examined with respect to pH and temperature. The pH optimum was pH 6.6, considerably lower than the pH range in which digesters are normally operated (pH 7.2-7.6). The optimum temperature was between 50 and 60^{0}C, rather than the 35-37^{0}C range in which most digesters are controlled.

0902 Alcohol Fuels

Refer also to citation(s) 33350, 33351, 33352, 33354, 33383, 33385, 33386

33357 (DOE/PC/70780–T10) **Modifiers in rhodium catalysts for carbon monoxide hydrogenation: Structure-activity relationships.** Bhore, N.A. Delaware Univ., Newark, DE (USA). Dept. of Chemical Engineering. May 1989. 424p. Sponsored by DOE Fossil Energy. DOE Contract FG22-84PC70780. Order Number DE89013802/JAW. Available from NTIS, PC A18/MF A01 - OSTI; GPO Dep.

This report is aimed at identifying interesting modified rhodium systems and elucidating structure-activity relationships in these systems with the overall goal of understanding the scientific issues in the catalytic conversion of syngas to oxygenates. Specific additives (sodium and molybdenum) are selected based on the scoping experiments. The effect of the additives on supported rhodium catalysts is then investigated. Throughout the investigation, experiments and analysis were performed on real systems instead of ideal systems. 374 refs., 82 figs., 57 tabs.

33358 (DOE/PC/80014–T1) **Direct synthesis of alcohol fuels over molybdenum-based catalysts: Final technical report, September 25, 1985–December 24, 1988.** Klier, K.; Herman, R.G.; Simmons, G.W.; Lyman, C.E.; Santiesteban, J.G.; Najbar, M.; Bastian, R. Lehigh Univ., Bethlehem, PA (USA). Dept. of Chemistry. Dec 1988. 260p. Sponsored by DOE Fossil Energy. DOE Contract AC22-85PC80014. Order Number DE89009888/JAW. Available from NTIS, PC A13/MF A01 - OSTI; GPO Dep.

The principal objective of this research project was to develop the scientific data needed to establish a technological and scientific foundation for a catalytic process for the direct selective conversion of hydrocarbon fuel. This research involved the preparation, catalytic testing, and characterization of alkali/MoS_2 catalysts that sometimes contain additional promoting or stabilizing components. The two principal goals initially addressed were: (1) to understand the functioning of alkali/MoS_2 catalysts in alcohol synthesis and to optimize the activity of these catalysts for high yields of fuel alcohols from low H_2/CO ratio sysnthesis gas, and (2) to develop a molybdenum oxide-based catalyst or a silica-based catalyst containing Pd, Rh, or Pt for the selective oxidation of methane to methanol or formaldehyde at elevated pressures. An auxiliary task of this research project that provided detailed scientific information concerning the structure and function of the heterogeneous catalyst, as

well as the crystal and defect structures that maintain the active catalyst and make it selective and durable under synthesis conditions. 154 refs., 93 figs., 32 tabs.

33359 (DOE/PC/90013–T8) **Optimum catalytic process for alcohol fuels from syngas: Eighth quarterly technical progress report, October–December 1988.** Union Carbide Corp., South Charleston, WV (USA). 27 Jan 1988. 40p. Sponsored by DOE Fossil Energy. DOE Contract AC22-86PC90013. Order Number DE89013783/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The objective of this report is to produce alcohol fuels from syngas. Several catalytic systems are being evaluated. This quarter, work continued on the molybdenum sulfide and cobalt molybdenum sulfide systems. 5 figs., 8 tabs. (cbs)

33360 (EUR–11843, pp. 58-67) **Selective production of alcohols from synthesis gas.** Chaumette, P. (Institut Francais du Petrole); Courty, P.; Martin, G.A.; Dalmon, J.A.; Meriaudeau, P.; Mirodatos, C.; Kiennemann, A.; Kieffer, R. Institut Francais du Petrole (IFP), 92 - Rueil-Malmaison (France). 1988. (CONF-8806366–: 1. contractors' meeting on the results of the subprogramme 'production and utilization of new energy vectors', Saarbruecken, Germany, F.R., 6-8 Jun 1988). In *Progress in synthetic fuels.*

Participants to this project have performed catalytic tests on model cobalt based active phases to first standardize their test and analysis procedure and have undertaken characterization studies of the evolution of these phases under syngas by in-situ magnetic measurements and chemical trapping. This work was further devoted to understanding the modification of the active sites under syngas and also to obtain predictive correlations between the active phase characteristics and the alcohol selectivity or the higher alcohol content of the alcohol mixture to be used as octane booster. In parallel new or improved active phases have been prepared and evaluated at pilot scale. With reference to former results, such active phases yield significantly higher alcohol selectivities for a given and optimized chain-growth rate, leading to further improvements of the overall synthesis technology. 15 refs., 8 figs., 3 tabs.

33361 (EUR–11843, pp. 73-80) **Development and screening of selective catalysts for the synthesis of clean liquid fuel.** Scholten, J.J.F. (Delft University of Technology (Netherlands). Faculty of Chemical Engineering and Chemistry); Xu Xiaoding. Technische Hogeschool Delft (Netherlands). 1988. (CONF-8806366–: 1. contractors' meeting on the results of the subprogramme 'production and utilization of new energy vectors', Saarbruecken, Germany, F.R., 6-8 Jun 1988). In *Progress in synthetic fuels.*

It is to be expected that alcohols and mixed alcohols will become predecessors of hydrogen as important fuels for the near future, especially in countries with abundant natural gas and coal resources. Alcohols can be used as a medium for energy storage, as domestic fuel and as a substitute for diesel and gasoline. They are energy carriers with high environmental potential, giving rise to a low emission of NO_x, polycyclic hydrocarbons and soot, good water solubility and minor long-term effects on atmosphere and soil. The synthesis gas needed for the production of alcohols can relatively easily be obtained from fossil fuels like coal and brown coal and also by steam reforming of natural gas. In this review the present knowledge in the field of methanol and higher alcohol synthesis will be summarized. Finally an explanation is presented of the joint research programme, started 1.02.1988. 24 refs.

33362 (PB–89-856330/XAB) **Alcohol fuels. January 1970-January 1989 (Citations from the US Patent data base). Report for January 1970-January 1989.** National Technical Information Service, Springfield, VA (USA). Feb 1989. 64p. Available from NTISPC N01/MF N01.

Supersedes PB–85-865988.

This bibliography contains citations of selected patents concerning production methods and the use of alcohols as internal combustion engine fuels. Descriptions of processes and equipment utilized in the production of motor fuels are included, and fuel control systems specifically designed for alcohol fuels are presented. Fuel additives used to inhibit corrosion caused by alcohol are also considered. (This updated bibliography contains 128 citations, 40 of which are new entries to the previous edition.)

33363 **Saponified vegetable oils as substitute diesel fuels.** Birrell, S.; Savage, L.D. v.v of Alternative energy in the Midwest. Illinois Dept. of Energy and Natural Resources, Springfield, IL (1987). (CONF-870366–: Alternative energy in the midwest: research and applications, Rosemont, Illinois, USA, 18-20 Mar 1987).

Technical Paper ILENR/AE-87/6.

The products and the pyrolytic distillation of crude soybeam oil were saponified with anhydrous ammonia gas. Microemulsions of the saponified distillate and aqueous ethanol were burnt in a direct-injection diesel engine to study performance characteristics and exhaust emissions, of the test fuels. Commercial No. 2-D diesel was used as the base reference fuel.

33364 **A summary of economic and engineering research at Argonne National Laboratory supporting a transition to methanol fuels for transportation.** Larsen, R.P. (Argonne National Lab., Energy and Environmental Systems Div., Center for Transportation Research (US)); Santini, D.J. v.v of Alternative energy in the Midwest. Illinois Dept. of Energy and Natural Resources, Springfield, IL (1987). (CONF-870366–: Alternative energy in the midwest: research and applications, Rosemont, Illinois, USA, 18-20 Mar 1987).

Technical Paper ILENR/AE-87/6.

The U.S. transportation system is in the early stages of a historically common but difficult period involving a major change in transportation fuels. As in the past, transportation in the United States has become excessively dependent on a single fuel whose domestic reserves are being exhausted. A transition from petroleum to be an alternative fuel that eventually is suitable for a significant part of the U.S. transportation system should begin on a large scale by the mid-1990s. This transition must be planned carefully to avoid rapidly increasing fuel prices and overdependence on petroleum from foreign fuel sources. This paper draws from research at Argonne National Laboratory (ANL) and summarizes the growing evidence supporting methanol as the preferred alternative transportation fuel of the future.

33365 **A state of the art survey of ethyl and methyl alcohol-based fuels including the feasibility of commercial scale production.** Protopapas, T.E. (Fuel and Mineral Resources, Inc., Reston, VA (US)). v.v of Alternative energy in the Midwest. Illinois Dept. of Energy and Natural Resources, Springfield, IL (1987). (CONF-870366–: Alternative energy in the midwest: research and applications, Rosemont, Illinois, USA, 18-20 Mar 1987).

Technical Paper ILENR/AE-87/6.

Alcohol is a prime candidate as a fuel to replace petroleum. The chemical structure of some of the more commonly known alcohols used as fuels. The raw materials base is abundant in the United States. Renewable Biomass, as well as vast coal resources can supply plentiful materials for conversion to alcohol. The future growth of the alcohol fuel industry, however, and the contribution of alcohol to reducing U.S. dependence on imported petroleum, depends on many technical, economic, financial, and public policy factors. The production technologies are known. Fermentation and distillation of sugars and starches to produce ethanol are age-old processes that modern technology is improving to increase yield and reduce costs. Gasification and liquefaction of woody plant materials and coal are processes that are well understood. American industry and science have been improving the methanol technologies for decades, and are working toward further improvements.

0904 Solid Waste and Wood Fuels

Refer also to citation(s) 33145, 33388, 33649

33366 (NME–1986) **The power of alternatives. Energy from wood and peat.** Graham, P.M. Mercy Hospital and Medical Center, Chicago, IL (USA). 1986. 130p. (CONF-8611290–: Wood and peat energy conference, Gander, Canada, 17-19 Nov 1986;MICROLOG–89-01972). Available from Dept. of Mines and Energy, PO Box 4750, St. John's, NF, Canada A1C 5T7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This meeting concerns the potential of wood and peat as alternative fuels in the province of Newfoundland, Canada. The resources

of the province are assessed, including an aerial survey of peat lands and an article on willows as an energy crop; peat harvesting is also discussed. Several examples of conversion of boilers from oil fuel to woodchip or peat fuels in plants, schools and hospitals of the province are presented, with emphasis on the economic impacts and payback period. All the wood burning applications use green, not dried, woodchips. All 9 papers have been abstracted.

33367 (NME–1986, pp. 31-42) **Wood-fired boiler project. James Paton Memorial Hospital, Gander, Newfoundland.** McDougall, A.R. (ShawMont Newfoundland Ltd., St. John's, NF, Canada). Mercy Hospital and Medical Center, Chicago, IL (USA). 1986. (CONF-8611290–: Wood and peat energy conference, Gander, Canada, 17-19 Nov 1986;MICROLOG–89-01972). In *The power of alternative. Energy from wood and peat.* Available from PRpt. of Mines and Energy, PO Box 4750, St. John's, NF, Canada A1C 5T7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A wood-fired boiler system was installed at the James Paton Memorial Hospital in Gander to replace the existing oil fired operation. The shared financing, design and construction of the installation are outlined. The capital cost was $1,008,500. Due to the drop in world oil prices, the true payback period is 19 years. Recommendations for future installations are given. 3 figs.

33368 (NME–1986, pp. 57-79) **Fuel peat demand and boiler conversion feasibility study. Energy demand and fuel peat conversion study Burin Peninsula.** Stapleton, G. (Provincial Consultants Ltd., St. John's, NF, Canada); Finch, D. Mercy Hospital and Medical Center, Chicago, IL (USA). 1986. (CONF-8611290–: Wood and peat energy conference, Gander, Canada, 17-19 Nov 1986;MICROLOG–89-01972). In *The power of alternative. Energy from wood and peat.* Available from Dept. of Mines and Energy, PO Box 4750, St. John's, NF, Canada A1C 5T7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This study examines the potential fuel oil displacement of fuel peat on the Burin Peninsula, Newfoundland, Canada, and the technical and financial viability of converting three facilities: a large fish processing plant, a medium size ship building plant, and an elementary school, to peat fired systems. The results of the study indicate that there is an actual fuel oil displacement potential of 15.7 million litres of fuel oil or 61,600 tonnes of fuel peat out of a total possible supply of 23.5 million tonnes available within economic range of the major population centres. A complete life cycle analysis was carried out for all three facilities. Of the three facilities examined, two of the three: the fishplant and the shipyard, are economically viable, while the school is marginally inviable. 3 figs., 7 tabs.

33369 **Direct combustion of crop residues for energy production.** Feely, A. (Great Lakes Regional Biomass Energy Program, Council of Great Lakes Governors, Madison, WI (US)). v.v of Alternative energy in the Midwest. Illinois Dept. of Energy and Natural Resources, Springfield, IL (1987). (CONF-870366–: Alternative energy in the midwest: research and applications, Rosemont, Illinois, USA, 18-20 Mar 1987).

Technical Paper ILENR/AE-87/6.

At present, the amount of crop residues combusted for energy is not well documented, although it is clearly minimal. The availability of cheaper oil has lessoned the sense of urgency regarding the need for research and development of alternative fuels: consequently, although there is a need for further research of combustion of agricultural residues for energy, such efforts have been curtailed in recent years. The purpose of the case studies contained in this paper is to document the experiences of energy users in the region who have burned agricultural residues for use in grain drying, industry, and for home heating. The three case studies described in this paper are taken from a selection of 18 case studies included in Combustion of Crop Residues for Energy. Given that research and development in this area is limited, the technology for combusting crop residues in understandably limited and, in many instances, prototypical. Most of the burners used in the region have been introduced to the market within the last few years or remain in the experimental stages; the $10,000-$25,000 price tags associated with most of them might be expected to become more competitive by the end of the decade, particularly if the cost of fuels begins to rise again.

33370 **Woody biomass production.** Burnett, C.D. (Illinois Natural History Survey, Champaign, IL (US)). v.v of Alternative energy in the Midwest. Illinois Dept. of Energy and Natural Resources, Springfield, IL (1987). (CONF-870366–: Alternative energy in the midwest: research and applications, Rosemont, Illinois, USA, 18-20 Mar 1987).

Technical Paper ILENR/AE-87/6.

Recent research on fuelwood production in North America has concentrated on the simple coppice method, a highly productive but capital-intensive method that provides few of the benefits desired by landowners. In contrast to the maximum-yield approach taken by advocates of the simple coppice method, the goal of this study was to design low-input woodland management methods that would provide benefits consistent with landowner objectives. In particular, the objective was to develop systems of fuelwood production that could also be used to control soil erosion on marginal farmland and to provide high-quality wildlife habitat. From an energy perspective, the strategy is to sacrifice high productivity for wider adoption, thereby compensating for lower yields. A review of the historical and ecological literature suggested that some of the lesser-known methods of fuelwood production methods may be better suited to the objectives of current landowners than the simple coppice system. To test this idea, experimental woodlots based on two traditional European woodland management systems were established.

0905 Liquid Waste Fuels

Refer also to citation(s) 33778

13 HYDRO ENERGY

33371 (DOE/ID/12118–2) **Spokane Upriver Dam Hydro Project operation and maintenance report, April, 1989.** Spokane Dept. of Water and Hydroelectric Services, WA (USA). 1989. 92p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FC07-80ID12118. Order Number DE89012871/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

Operational experience gained at Upriver Dam Hydroelectric Project in these past few years is unique. Powerhouse No. 2 with the two units went on line in July of 1984 adding three times the original capacity. This created different flow patterns in the canal. Installing units made by a foreign company (Fuji, Japan) also had some advantages and disadvantages. Finally, an embankment washout accident on May 20, 1986, provided valuable lessons. However, for a project which was not licensed until 1981 and thus had very little dealings with the regulatory agencies, the FERC licensing and subsequent compliance have had their periods of frustration and has occupied considerable staff time with associated expenses. The operational experience gained in this project is very valuable for the hydroelectric generating industry. This report is written to fulfill requirements of the Department of Energy (DOE) as per the cooperative agreement No. FC07-80ID12118. This report supplements the final technical and construction cost report published by DOE in December 1984 (DOE/ID/12118). Normally, this report should have covered the period July 1984 through June 1986. However, due to the washout incident as aforementioned, the period was prolonged to cover an additional six months from the time the powerhouse rehabilitation was completed. Thus, the report covers the period until the end of 1987. 4 figs.

1301 Resources and Availability

33372 (EC/IWD–1988AP) **Atlantic provinces historical water levels summary, to 1987.** Environment Canada, Ottawa, ON (Canada). Inland Waters Directorate. 1988. 37p. (In English and French). (MICROLOG–89-01191). Available from Water Survey of Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, Canada K1A 0E7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A summary is presented of monthly and annual mean water levels and annual extremes of water levels for lakes and rivers in the Canadian Atlantic provinces for which water level data to 1987 inclusive have been collected. Historical data are included, going as far back as the early decades of this century when hydrometric investigations in Nova Scotia were conducted by the Dominion Water Power Branch in cooperation with the Nova Scotia Water Power Commission. Descriptive information about the gauging stations is also included, such as location, drainage area and whether the flow is natural or regulated.

33373 (EC/IWD–1988BC) **British Columbia historical water levels summary, to 1987.** Environment Canada, Ottawa, ON (Canada). Inland Waters Directorate. 1988. 185p. (In English and French). (MICROLOG–89-01193). Available from Water Survey of Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, Canada K1A 0E7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A summary is presented of monthly and annual mean water levels and annual extremes of water levels for lakes and rivers in British Columbia for which water level data to 1987 inclusive have been collected. Historical data are included, going as far back as the first decade of this century, when stream-measurement work began primarily for irrigation supply purposes and was later continued by the Dominion Water Power Branch. Descriptive information about the gauging stations is also included, such as location, drainage area and whether the flow is natural or regulated.

33374 (EC/IWD–1988MB) **Manitoba historical water levels summary, to 1987.** Environment Canada, Ottawa, ON (Canada). Inland Waters Directorate. 1988. 152p. (In English and French). (MICROLOG–89-01190). Available from Water Survey of Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, Canada K1A 0E7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A summary is presented of monthly and annual mean water levels and annual extremes of water levels for lakes and rivers in Manitoba for which water level data to 1987 inclusive have been collected. Historical data are included, going as far back as the first decade of this century, when stream gauging work was begun by the Dominion Water Power Branch. Descriptive information about the gauging stations is also included, such as location, drainage area and whether the flow is natural or regulated.

33375 (EC/IWD–1988O) **Ontario historical water levels summary, to 1987.** Environment Canada, Ottawa, ON (Canada). Inland Waters Directorate. 1988. 153p. (In English and French). (MICROLOG–89-01192). Available from Water Survey of Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, Canada K1A 0E7;MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A summary is presented of monthly and annual mean water levels and annual extremes of water levels for lakes and rivers in Ontario for which water level data to 1987 inclusive have been collected. Historical data are included, going as far back as the first decade of this century when hydrometric survey operations were carried out by the Hydro-Electric Power Commission of Ontario. Descriptive information about the gauging stations is also included, such as location, drainage area and whether the flow is natural or regulated.

1303 Plant Design and Operation

33376 (OME–1988, pp. 13) **Overflow embankment dams in Small Hydro Powers of China.** Xianhuan, W. (Hangzhou Regional Centre (Aaia-Pacific) for Small Hydro Power). Ontario Ministry of Energy, Toronto, ON (Canada). 1988. (CONF-880711–: Small hydro '88: international conference and trade show, Toronto, Canada, 4-9 Jul 1988;MICROLOG–89-02657;CE–02581). In *Small hydro '88. An international conference and trade show. Proceedings, vol. 2.* Available from Ontario Ministry of Energy, Communications Services Group, 62 Wellesley St., West, Main Floor, Toronto, ON, Canada M7A 2B7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Since the 1950s China began to study the overflow embankment dam. Lab tests were mainly focused on the structural details of slope protection and on hydraulic problems, including energy dissipation. The Beliashevski-type of rockfill dams was first constructed in the early 1950s in the Ukraine; 3 examples are briefly discussed. The first Beliashevski-type rockfill dams and overflow earth dams were built in China in the late 1950s. China has built more than 200 overflow embankment dams, of which about 30 are of the earthfill type. Some of the existing overflow earth dams have never overflowed yet, due to overestimation of run-off, and most of them had some troubles after completion or operation. The author describes the Jiaoshi dam in the Jiangxi province (earthfill type with concrete core), the Hengpaiton dam in the Anhui province, the Hangxing dam in the Hunan province, the rockfill dams at Chaoguche in the Zhejiang province and at Laxia in the same province. The Zhejiang Provincial Hydraulic Research Centre has made model tests on the discharge capability and throwing distance of various crest types, of which 3 are recommended. The corresponding mathematical theory is provided. The author describes the rockfill dams at Ruigang in the Jiangxi province and at Jiaoling in the Guangdong province, the latter being of the hard shell type, and the masonry dam at Baizhangji in the Zhejiang province. The advantages and disadvantages of these various types of dams are compared. 4 refs., 13 figs.

1306 Environmental Aspects

33377 (DOE/BP/16726–4) **Changes in habitat and populations of steelhead trout, coho salmon and chinook salmon in Fish Creek, Oregon, 1983–1987, as related to habitat improvement: Annual report, 1987.** Everest, F.H.; Reeves, G.H.; Sedell, J.R.; Hohler, D.B.; Cain, T.C. Forest Service, Corvallis, OR (USA). Forestry Sciences Lab.; Mount Hood National Forest, Estacada, OR (USA). Estacada Ranger District. Jun 1989. 115p. Sponsored by DOE Management & Administration. DOE Contract AI79-84BP16726. Order Number DE89013098/JAW. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

Implementation activities on Fish Creek are scheduled to be completed by 1988. At the end of the habitat improvement program, it is anticipated that at least 80 percent of the habitat available to anadromous fish will have been affected. A total of $165,300 was budgeted for planning, project implementation, and the Fish Creek evaluation in 1987. This paper will focus on the projects completed in the basin in 1987, and the evaluation of projects constructed during the 1986–1987 period. Coho salmon and steelhead trout smolt production, and changes in physical habitat structure and spawning gravel related to addition of boulders and large woody debris to the channel, will be emphasized. 14 refs., 40 figs., 25 tabs.

33378 (DOE/BP/17622–2) **Operation, maintenance and evaluation of the Bonifer and Minthorn springs juvenile release and adult collection facilities: Annual report, 1987.** Lofy, P.T.; James, G. Confederated Tribes of the Umatilla Indian Reservation, Pendleton, OR (USA). Apr 1989. 28p. Sponsored by DOE Management & Administration. DOE Contract AI79-84BP17622. Order Number DE89013096/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The Confederated Tribes of the Umatilla Indian Reservation and Oregon Department of Fish and Wildlife are cooperating in a joint effort to increase steelhead and re-establish salmon runs in the Umatilla River Basin. As part of this program, Bonifer and Minthorn Acclimation Facilities are operated for holding adult steelhead and acclimation and release of juvenile steelhead and salmon. Regularly-scheduled maintenance was completed in 1987. Rock fill was brought in at Minthorn and gravel cleared from the outlet of Bonifer to repair damages from the flood of 1986. Facility upgrading was completed, and equipment and pumps received regular maintenance and repair. A survey was completed to determine the change of the Umatilla River contour in the vicinity of Minthorn after the flood. About 150 adult steelhead were collected at Threemile Dam January–April and held at Minthorn. Sixty-seven fish were spawned, and 239,760 eggs were transferred to Irrigon Hatchery for incubation. 2 refs., 2 figs., 9 tabs.

33379 (DOE/BP/36834–1) **Demonstration of a system for removing malachite green: Final report.** Marking, L.L. National

Fisheries Research Center-Great Lakes, Ann Arbor, MI (USA). Apr 1989. 42p. Sponsored by DOE Management & Administration. DOE Contract AI79-87BP36834. Order Number DE89013095/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Activated carbon has been used effectively to remove tastes, odors, and contaminants from public water supplies. The adsorption efficiency is influenced by the size of carbon granules, flow rate, column depth, and retention time. A study was designed to (1) determine the type of filter and kind of carbon that was most efficient and (2) demonstrate that carbon filters can be used to remove malachite green from water used for egg incubation or to hold adult salmon before spawning. Minicolumn simulation studies showed that 8 × 30 mesh granular carbon manufactured from bituminous coal was effective for continuously removing malachite green from water for 230 days at a flow rate of 500 gpm and for 62 days at a flow rate of 1000 gpm. The removal capacity at the slower flow rate was 69 mg of malachite green per gram of carbon. A filter system that contained 20,000 pounds of activated carbon in each of two chambers was effective for removal of malachite green from treated water in adult salmon holding ponds at flows of 500 gpm and greater. The removal efficiency was 99.8% after 105 hours of operation, and the adsorption capacity of the system was projected to be 20 or more years of routine hatchery operation. A filter system that contained 2000 pounds of activated carbon in each of two chambers was effective for removal of malachite green from treated water in salmon egg incubation units at the designated flow rate of 50 gpm and also at faster flow rates. 14 refs., 5 figs., 6 tabs.

14 SOLAR ENERGY

1401 Resources and Availability

Refer also to citation(s) 33405, 33406

33380 **Variations in United States sunshine.** Pittalwala, I. (Institute for Atmospheric Sciences, Dept. of Mechanical Engineering, State Univ. of New York, Stony Brook, NY (US)); Hameed, S. v.v of Solar '88 (Technical Papers). Coleman, M.J. American Solar Energy Society, Boulder, CO (1988). (CONF-880615–: Solar '88: American Solar Energy Society annual meeting and 13th national passive solar conference, Cambridge, Massachusetts, USA, 18-24 Jun 1988).

An investigation of the instrumentally recorded sunshine durations in the United States during 1908-1984 is presented. The observed fractions of astronomically possible sunshine durations vary significantly with season and over different geographical regions of the United States. It is shown that the change from the thermometric recorder to the photoelectric instrument in 1953 did not cause a statistically significant contamination of monthly sunshine data. Examination of changes between 1908 and 1984 in different regions indicates that monthly and seasonal sunshine durations fluctuate substantially on the interannual and decadal time scales. Several regions of the U.S. also display significant trends, with net changes of the order of ten percent between 1908 and 1984.

33381 **Comparison of sky luminance maps with instantaneous all-sky images.** LeBaron, B.A. (Pacific Northwest Lab., P.O. Box 999, Richland, WA (US)); Larson, N.R.; Michalsky, J.J. v.v of Solar '88 (Technical Papers). Coleman, M.J. American Solar Energy Society, Boulder, CO (1988). (CONF-880615–: Solar '88: American Solar Energy Society annual meeting and 13th national passive solar conference, Cambridge, Massachusetts, USA, 18-24 Jun 1988).

Daylighting designers and modelers require more information than can be provided by measures of the total illuminance arriving at a surface. A knowledge of the luminance spatial distribution is critical to predicting interior penetration. A qualitative comparison of contour maps, generated from a series of point measurements around the sky dome, and concurrent instantaneous all-sky photographs is made for clear, overcast, and partly cloudy conditions. Standard models for calculating luminance are also compared. It is shown that a discrete set of all-sky measurements, requiring 3 minutes to complete, are adequate to qualitatively capture the structure in the luminance distribution, even under rapidly changing cloud conditions.

33382 **Design and development of a rotating shadowband radiometer solar radiation/daylight network.** Michalsky, J.J. (Atmospheric Sciences Research Center, State Univ. of New York, Albany, NY (US)); Perez, R.; Stewart, R.; LeBaron, B.A.; Harrison, L. v.v of Solar '88 (Technical Papers). Coleman, M.J. American Solar Energy Society, Boulder, CO (1988). (CONF-880615–: Solar '88: American Solar Energy Society annual meeting and 13th national passive solar conference, Cambridge, Massachusetts, USA, 18-24 Jun 1988).

Solar radiation data are needed to properly design solar/daylighting systems. The data that exist are often short-term, nonlocal, or of uncertain accuracy. The modest amount of high quality data that exist were obtained with costly equipment, attentive maintenance, and conscientious quality control. A solar radiation measurement plan is being considered for New York State that seeks to minimize costs by deploying a network of rotating shadowband radiometers. These instruments perform three basic solar measurements (direct beam, diffuse and global horizontal) with a single detector. Much of the data retrieval and quality control is performed by computer to minimize maintenance costs and downtime. Descriptions of the instrument, network as currently conceived, and data processing plans are presented.

1403 Economics

Refer also to citation(s) 33364, 33365

1404 Environmental, Legal, and Institutional Aspects

Refer also to citation(s) 33412

1405 Solar Energy Conversion

Refer also to citation(s) 33350, 33351, 33352, 33354, 33355, 33363, 33364, 33365, 33366, 33369, 33370, 33401, 33404, 33649, 33778, 33985, 33990, 34021, 34031, 34520

33383 (AFME–86.11.0245) **Biochemistry and genetics of cellulose degradation Proceedings.** Agence Francaise pour la Maitrise de l'Energie, 75 - Paris. Sep 1987. 113p. (CONF-8709419–: FEMS symposium, Paris, France, 7-9 Sep 1987;AFME–86.11.0600). Order Number DE88757223/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

The three main lines of the symposium on biochemistry and genetics of cellulose degradation are: characterization and properties of the enzymes involved in cellulose degradation (fungal and bacterial cellulases), cloning and expression of the cellulase genes, genetics of cellulolytic microorganisms (genetics of cellulases in Erwinia ch.,...) and biodegradation of hemicellulose and lignocellulose.

33384 (DOE/ER/13369–4) **[Cloning, characterization, and expression of genes/cDNA encoding lignin peroxidases in Phanerochaete chrysosporium, a white-rot basidiomycete]: Progress report, 1988–1989.** Michigan State Univ., East Lansing, MI (USA). 1989. 6p. Sponsored by DOE Energy Research. DOE Contract FG02-85ER13369. Order Number DE89013670/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Progress has been made in 1988–1989 on a number of different research fronts focussing on the molecular biology of Phanerochaete chrysosporium. These include the cloning, sequencing and characterization of a gene that encodes the lignin peroxidase H2 protein, characterization of der mutants in which lignin peroxidases are no longer subject to nitrogen regulation, and characterization of a lignin peroxidase (LIP) mutant. The latter mutants will be valuable tools for future studies on the genetics of lignin degradation system and for a better understanding of the physiological role of individual lignin peroxidase proteins in lignin degradation. We have also characterized a novel shuttle vector-based, non-integrative transformation system for P. chrysosporium which will very useful for conducting detailed molecular genetic studies on this organism.

33385 (IAEA-TECDOC–486, pp. 153-162) **Cell immobilization and its application to biomass conversion.** Kaetsu, I. (Japan Atomic Energy Research Establishment, Takasaki (Japan). Takasaki

Radiation Chemistry Research Establishment). International Atomic Energy Agency, Vienna (Austria). Dec 1988. (CONF-8706397–: Final research co-ordination meeting on application of radiation technology in immobilization of bioactive materials, Beijing, China, 15-18 Jun 1987). In *Radiation technology for immobilization of bioactive materials. Proceedings of the final research co-ordination meeting held in Beijing, 15-18 June 1987.* Order Number DE89617908/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

The author's group developed an immobilization method by physical entrapping using radiation polymerization. The technique has been used for the immobilization and culture of cellulase producing fungi for the purpose of biomass conversion. In this process, various cellulosic wastes such as chaff, bagasse and so on were pre-treated by means of irradiation and mechanical crushing into fine powders for the enhanced enzymatic saccharification. The pretreatment effect was enhanced remarkably by the addition of alkali. The crushed waste slurry was hydrolyzed with cellulase soap as a culture product of cellulase producing cells, such as Trichoderma reesei and sportrichum fungus. Those cells were immobilized and cultured in a fibrous radiation polymerized support and showed the prolonged enzyme production in the continuous long culture of the immobilized fungi. Immobilization and culture of yeast were studied and gave the successful results for the enhanced ethanol fermentation of glucose, which was brought by the continuous saccharification of wastes. (author). 16 refs, 5 figs.

33386 (IAEA-TECDOC–486, pp. 163-170) **Biomass conversion through radiation immobilization of enzymes and microorganisms and pre-irradiation techniques at IPEN/CNEN, Sao Paulo.** Castagnet, A.C.G. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil)). International Atomic Energy Agency, Vienna (Austria). Dec 1988. (CONF-8706397–: Final research co-ordination meeting on application of radiation technology in immobilization of bioactive materials, Beijing, China, 15-18 Jun 1987). In *Radiation technology for immobilization of bioactive materials. Proceedings of the final research co-ordination meeting held in Beijing, 15-18 June 1987.* Order Number DE89617908/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

The search for alternative renewable sources of energy is receiving increasing attention in developed and less developed countries. At the IPEN-CNEN/SP several interconnected radiation technology applications in the field of biomass conversion have been developed, which included: (1) wood powdering of pre-irradiated wood chips for fuel production; (2) saccharification of lignocellulosic materials by combining electron beam processing (EBP) with other physical and chemical pre-treatments; (3) radiation immobilization of enzymes and microorganisms (yeasts) used in the saccharification of lignocellulosic wastes and ethanol production processes; (4) production of complementary cattle feed by NH_3 and NaOH impregnation of pre-irradiated sugarcane bagasse; (5) study of radiosensitivity of yeast cells and yeast ethanol production system; (6) initial tests of bioreactivity of radiation-induced polymers. (author). 19 refs, 2 tabs.

33387 (LBL–27155) **A molecular genetic analysis of carotenoid biosynthesis and the effects of carotenoid mutations on other photosynthetic genes in Rhodobacter capsulatus.** Armstrong, G.A. Lawrence Berkeley Lab., CA (USA). Apr 1989. 248p. Sponsored by DOE Energy Research. DOE Contract AC03-76SF00098. Order Number DE89012995/JAW. Available from NTIS, PC A12/MF A01 - OSTI; GPO Dep.

The nine known R. capsulatus carotenoid genes are contained within the 46 kilobase (kb) photosynthesis gene cluster. An 11 kb subcluster containing eight of these genes has been cloned and its nucleotide sequence determined. A new gene, crtK, has been located in the middle of the subcluster. The carotenoid gene cluster contains sequences homologous to Escherichia coli ω^{70} promoters, rho-independent transcription terminators, and prokaryotic transcriptional factor binding sites. The phenotypes and genotypes of ten transposon Tn5.7 insertion mutations within the carotenoid gene cluster have been analyzed, by characterization of the carotenoids accumulated and high resolution mapping of the Tn5.7 insertions. The enzymatic blockages in previously uncharacterized early carotenoid mutants have been determined using a new in vitro synthesis system, suggesting specific roles for the CrtB and CrtE gene products. The expression of six of the eight carotenoid genes in the cluster is induced upon the shift from dark chemoheterotrophic to anaerobic photosynthetic growth. The magnitude of the induction is equivalent to that of genes encoding structural photosynthesis polypeptides, although the carotenoid genes are induced earlier after the growth shift. Different means of regulating photosynthesis genes in R. capsulatus are discussed, and a rationale for the temporal pattern of expression of the carotenoid genes during photosynthetic adaptation is presented. Comparison of the deduced amino acid sequences of the two dehydrogenases of the R. capsulatus carotenoid biosynthesis pathway reveals two regions of strong similarity. The effect of carotenoid mutations on the photosynthetic phenotype has been studied by examining growth rates, pigments, pigment-protein complexes and gene expression for a complete set of carotenoid mutants. 161 refs.

33388 (NME–1986, pp. 109-120) **Energy forests. An overview.** Van Nostrand, R.S. (Canadian Forestry Services, Pleasantville, St. John's, NF, Canada). Mercy Hospital and Medical Center, Chicago, IL (USA). 1986. (CONF-8611290–: Wood and peat energy conference, Gander, Canada, 17-19 Nov 1986;MICROLOG–89-01972). In *The power of alternative. Energy from wood and peat.* Available from Dept. of Mines and Energy, PO Box 4750, St. John's, NF, Canada A1C 5T7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Growing short-rotation forest crops to maximize biomass on a large scale for energy is a relatively new concept which began in Scandinavia, Ireland and England about 15 years ago. Promising results from these European trials provided the initiative for research in energy crops in Newfoundland which began about six years ago using willows (Salix Spp.). Yields of up to 20 ton (drymass)/hectare/y have been demonstrated, but a mean production level of 8 to 12 ton (drymass)/hectare/y is a practical objective. In addition to field trials, emphasis is also being placed on biogeographical and biometeorological studies to ensure best clone/site matching. Large-scale establishment of energy plantations in Canada is unlikely in the medium term; however, they could have limited application in areas which have high-cost fossil fuel requirements, but have limited access to conventional forest crops which could be used as an alternative energy source. 7 refs., 1 tab.

33389 (PB–89-142590/XAB) **Energy transfer and photochemistry in biomimetic solar conversion. Annual report, October 1987-September 1988.** Boxer, S.G. Stanford Univ., CA (USA). Dept. of Chemistry. Sep 1988. 12p. Available from NTIS, PC A03/MF A01.

See also PB–88-130026.

This research program aims at developing methods for studying electron transfer reactions and electron transfer in biomimetic solar-energy systems. During the past year, research focused on the use of applied electric fields to study the nature of photoexcited states that decay into ion pairs by electron transfer and direct control of electron transfer reaction dynamics by application of electric fields. The effects of electric fields on the absorption or emission spectrum of a molecule (the Stark effect) provides information on the change in dipole moment associated with the transition. The first Stark effect spectra were obtained for a transition metal complex in a polymer film. The absorption Stark effect for a series of Ru complexes demonstrates the very dipolar nature of the initially excited state. The rate of the initial electron transfer in photosynthetic-reaction centers was slowed by application of an electric field. An analysis of the fluorescence anisotropy induced by the field provided detailed information on the mechanism of the initial charge-separation step in photosynthesis.

33390 (PTB-Opt–29) **Spectroradiometric analysis of silicon for photovoltaic solar energy conversion.** Metzdorf, J.; Holstenberg, H.C.; Sperling, A.; Wittchen, T.; Huenerhoff, D.; Kaase, H. Physikalisch-Technische Bundesanstalt, Braunschweig (Germany, F.R.). Abt. Optik; Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). Jan 1989. 74p. (In German). Order Number DE89783056/JAW. Available from NTIS (US Sales Only), PC A04/MF A01;1.

For accurate calibration of terrestrial reference solar cells made of crystalline or amorphous silicon DLTS and various spectroradiometric methods have been combined. The following diagnostic techniques for the nondestructive characterization of large-area solar cells with respect to the quality of the material that is connected with and important to conversion efficiency have been developed: The 'differential spectral responsivity method' for the analysis of nonlinearities, the 'constant differential photosignal method' for the steady-state determination of the mean value of an effective irradiance-dependent diffusion length of the minority carriers in the base; the 'short circuit current response method' for the time-resolved analysis of trap effects and trap-induced response times. (orig./ORU) With 35 refs., 1 tab., 29 figs.

33391 (SERI/STR–211-3512) **Research on stable, high-efficiency, large-area, amorphous-silicon-based submodules, task B: Semiannual subcontract report, 1 September 1988–28 February 1989.** Eberspacher, C.; Ermer, J.; Tanner, D. Solar Energy Research Inst., Golden, CO (USA); ARCO Solar, Inc., Camarillo, CA (USA). May 1989. 76p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract AC02-83CH10093. Order Number DE89009430/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

The primary objective of the research described in this report is to develop processes for fabricating stable, high-efficiency, single-junction and tandem cells and submodules based on thin-film silicon:hydrogen alloys (TFS). The focus is on developing a four-terminal hybrid tandem junction consisting of a copper indium diselenide (CIS) bottom circuit and a semitransparent TFS top circuit. A principal objective is to explore area-related processing problems that affect junction and large-area module performance. Tandem cell samples developed in this work were measured at 14.6% efficiency in the laboratory, and single-junction CIS cells at 14.1% efficiency. Film deposition and patterning processes were successfully extended to 0.4-m^2 substrates. Submodule performance (3900 cm^2) is approaching that demonstrated earlier on smaller submodules (940 cm^2), which confirms the scalability of thin-film PV processing. Environmentally durable packaging techniques were developed for single-junction and tandem modules. TFS module stability is limited by Staebler-Wronski effects, while CIS module stability is encouraging. 15 refs., 32 figs., 9 tabs.

33392 Harvesting trials in a sycamore biomass energy plantation in Alabama. Woodfin, S. (Tennessee Valley Authority, Norris, TN (US)); Stokes, B.; Frederick, D.; Lea, R.; Cunningham, M. v.v of Solar '88 (Technical Papers). Coleman, M.J. American Solar Energy Society, Boulder, CO (1988). (CONF-880615–: Solar '88: American Solar Energy Society annual meeting and 13th national passive solar conference, Cambridge, Massachusetts, USA, 18-24 Jun 1988).

Three harvesting systems were evaluated and analyzed for productivity and costs in a short rotation, intensive culture plantation of 2-5 year old sycamore. Individual machines were compared to create an optimum system.

33393 An evaluation of the bioconversion of woody biomass to calcium acetate deicing salt. Wise, D.L. (Cambridge Scientific, Inc., Executive Offices, 195 Common Street, Belmont, MA (US)); Augenstein, D. v.v of Solar '88 (Technical Papers). Coleman, M.J. American Solar Energy Society, Boulder, CO (1988). (CONF-880615–: Solar '88: American Solar Energy Society annual meeting and 13th national passive solar conference, Cambridge, Massachusetts, USA, 18-24 Jun 1988).

A competitive process is described using local woody biomass residues, which may also include associated pulp and paper wastes, or municipal solid waste, as potential feedstocks for bioconversion to calcium acetate, an alternative deicing salt. The process first involves suppressed methane fermentation of these woody biomass residues in a packed bed fermentor for the production of acetic acid. In earlier experimental work, operation of conventional anaerobic digestion systems in this suppressed methane mode has yielded a product of over 85% acetic acid, the remainder primarily being other organic acids such as propionic and butyric acids; operation at thermophilic conditions (60^{0}C) yielded essentially all acetic acid.

33394 Overview of amorphous silicon photovoltaic technology. Ohi, J. (Solar Energy Research Institute, Golden, CO (US)); Stafford, B.; Wallace, W.; Luft, W.; Sabisky, E. v.v of Solar '88 (Technical Papers). Coleman, M.J. American Solar Energy Society, Boulder, CO (1988). (CONF-880615–: Solar '88: American Solar Energy Society annual meeting and 13th national passive solar conference, Cambridge, Massachusetts, USA, 18-24 Jun 1988).

The authors discuss how the results of a unique government-industry research project have helped the U.S. maintain competitiveness in amorphous silicon photovoltaic technology, a high-technology field invented in the U.S. but pursued vigorously and successfully by researchers in Japan. The authors describe recent advancements in materials science and improvements in the device structure and performance of hydrogenated amorphous silicon (a-Si:H) photovoltaic technology. In materials science, the authors describe a better theoretical understanding of photo-instability; the further exploration of alternative deposition processes; and the development of alloys, microcrystalline doped layers, and textured transparent conducting contact layers. In device structure, the authors report developments in multi-junction, multibandgap cells and modules. Both two-terminal and four-terminal structures are described. In performance, the authors report that a-Si:H photovoltaic modules are generating electricity in grid-connected systems and that long-term field testing shows improvements in the stability of commercially available a-Si:H photovoltaic modules.

33395 Black locust. Miller, R.O. (Dept. of Forestry, Michigan State Univ., East Lansing, MI (US)); Bloese, P.D.; Hanover, J.W. v.v of Energy from biomass and wastes XI. Klass, D.L. Institute of Gas Technology, Chicago, IL (1988). (CONF-870364–: 11. IGT conference on energy from biomass and wastes, Orlando, Florida, USA, 16-20 Mar 1987).

Energy production from biomass feedstocks contributes substantially to the national energy budget, especially in the Lake States. The versatility of woody-biomass feedstocks and predicted shortages of petroleum have prompted interest in biomass energy throughout the country. Research to identify the best species and management systems for the Lake States began in Michigan in 1978, with emphasis on improving productivity through short-rotation intensive culture plantations. Hybrid poplar is often considered a prime candidate species for energy production, but our work has shown that black locust is a better choice under most Lake States conditions. This paper presents evidence from several long-term studies which have been established at Michigan State University to substantiate this conclusion. The three studies which are reviewed are: A series of two species screening trials, from which black locust was eventually chosen as the best woody-biomass candidate; A growth analysis study of two black locust plantations on harsh sites in Michigan, from which the limits of black locust's productive range may be discerned; A comprehensive genetic testing and screening program, in which species variation is being explored and captured for the improvement planting stock; An introduction to black locust as a species is also presented.

33396 Economic evaluations of multiple rotation SRIC biomass plantations. Strauss, C.H. (School of Forest Resources, The Pennsylvania State Univ., PA (US)); Grado, S.S.; Blankenhorn, P.R.; Bowersox, T.W. v.v of Solar '88 (Technical Papers). Coleman, M.J. American Solar Energy Society, Boulder, CO (1988). (CONF-880615–: Solar '88: American Solar Energy Society annual meeting and 13th national passive solar conference, Cambridge, Massachusetts, USA, 18-24 Jun 1988).

A series of short-rotation intensive culture (SRIC) Populus plantations were evaluated in tandem with alternate harvesting and storage strategies to determine the least cost method for supplying biomass. The lowest plantation costs averaged \$32 Mg^{-1}(OD). Harvesting and storage requirements nearly doubled the final costs, with the least cost system having an average total cost of \$66 Mg^{-1}(OD).

33397 Scanning tunneling microscope and complementary microchemical investigations of hydrogen and shallow acceptors at silicon grain boundaries. Kazmerski, L.L. (Solar Energy Research Institute, Golden, CO (USA)). v. of Eighth E.C. photovoltaic solar energy conference. Volume 1. Solomon, I.; Equer, B.; Helm, P. (eds.) Kluwer Academic Publishers, Dordrecht, Netherlands (1988). DOE Contract AC02-83CH10093. (CONF-880513–: 8.

European Communities photovoltaic solar energy conference, Florence, Italy, 9-13 May 1988).

The passivation of grain boundaries and the neutralization of impurities in polycrystalline silicon, important processes for the improvement of performance of devices fabricated from this material, are investigated using micron- to atomic level spectroscopic techniques. The incorporation of hydrogen into grain boundaries is investigated using surface analysis methods. Volume-mapping techniques are used to identify the bonding mechanisms of the hydrogen in oxygen-free and oxygen-rich intergrain regions. Interactions between shallow acceptors (B, Al, Ga and In) and hydrogen in polycrystalline Si are studied. The bonding mechanisms involved in the acceptor neutralization process at the grain boundaries are evaluated using microanalytical techniques. Volume-indexed AES and Auger difference spectroscopy data are complemented by scanning tunneling microscope spectroscopic images to confirm the direct hydrogen-silicon bonding in boron-doped grain boundaries and hydrogen-acceptor bonding in Al-doped material. 6 figs., 12 refs.

33398 Photovoltaic concentrator technology. Recent results. Boes, E.C. (Sandia National Labs., Albuquerque, NM (USA)). v. of Eighth E.C. photovoltaic solar energy conference. Volume 1. Solomon, I.; Equer, B.; Helm, P. (eds.) Kluwer Academic Publishers, Dordrecht, Netherlands (1988). DOE Contract AC04-76DP00789. (CONF-880513–: 8. European Communities photovoltaic solar energy conference, Florence, Italy, 9-13 May 1988).

The recent results in photovoltaic concentrator technology development are discussed. The major topics presented are a detailed description of current concentrator module development efforts, a summary of concentrator component development, and a discussion of the economics of photovoltaic concentrators in light of these activities and the higher concentrator cell efficiencies that have been demonstrated. 2 figs., 6 refs., 2 tabs.

33399 Photoelectrochemistry of TiO_2 thin films with RuO_2 overlayers. Smyrl, W. (Corrosion Research Center and Dept. of Chemical Engineering and Materials Science, Univ. of Minnesota, Minneapolis, MN (US)); Kozlowski, M.R.; Tyler, P.S.; Atanasoski, R. v.v of Proceedings of the 1987 Electrochemical Society spring meeting: Extended abstracts. Volume 87-1. The Electrochemical Society, Pennington, NJ (1987). (CONF-870560–: 171. Electrochemical Society meeting, Philadelphia, Pennsylvania, USA, 10-15 May 1987).

The practice of using a mixture of RuO_2 and TiO_2 as a catalyst for oxygen evolution has been successfully employed in the electrolytic industry for three decades. The success of this mixture can be attributed to the outstanding electrocatalytic properties of RuO_2 and the stability of the mixture of the two components. To further exploit the use of these materials in catalyzing the water decomposition reaction, one can look towards combining the photoactive semiconductor properties of TiO_2 with the already established catalytic properties of this system. Two geometries for photoelectrode construction immediately present themselves: (1) A layered structure with a thin film of RuO_2 covering a TiO_2 substrate, (2) An alloy of the two oxides producing either a homogeneous distribution of RuO_2 or some type of network configuration. The aim of this study is to clarify the effect of RuO_2 overlayers on thin film TiO_2 substrates. Both thermally and anodically grown TiO_2 films are examined and the RuO_2 overlayers are applied by using a standard procedure of thermal decomposition of $RuCl_3$.

33400 High-efficiency indium tin oxide/indium phosphide solar cells. Li, X. (Solar Energy Research Institute, 1617 Cole Boulevard, Golden, Colorado 80401(US)); Wanlass, M. W.; Gessert, T. A.; Emery, K. A.; Coutts, T. J. *Applied Physics Letters (USA)*, 54(26): 2674-2676 (26 Jun 1989). DOE Contract AC02-83CH10093.

Improvements in the performance of indium tin oxide/indium phosphide (ITO/InP) solar cells have been achieved by using dc magnetron sputter deposited *n*-ITO onto an epitaxial p/p^+ structure grown on good quality commercial p^+ bulk substrates. The composition of the sputtering gas has been investigated and the highest efficiency cells resulted when the surface of the epilayer was exposed to an Ar/H_2 plasma before depositing the bulk of the ITO in a more typical Ar/O_2 plasma. With H_2 processing, record efficiencies of 18.9% global, 1000 W m^{-2}, 25 °C (17.0% air mass zero) were achieved. Without H_2 processing, the devices exhibited lower efficiencies and were unstable. Type conversion of the InP was shown to occur and was established as being associated with the ITO (possibly due to Sn donors) rather than sputter damage. These improvements in performance have resulted from the optimization of the doping, thickness, transport, and surface properties of the *p*-type base, as well as from better control over the ITO deposition procedure.

1406 Photovoltaic Power Systems

Refer also to citation(s) 33354, 33398, 33409, 33415

33401 A graphical design tool for stand-alone photovoltaic/storage systems. Bloom, D.R. (Univ. of Lowell, One Univ. Avenue, Lowell, MA (US)); Duffy, J.J.; Berg, W. v.v of Solar '88 (Technical Papers). Coleman, M.J. American Solar Energy Society, Boulder, CO (1988). (CONF-880615–: Solar '88: American Solar Energy Society annual meeting and 13th national passive solar conference, Cambridge, Massachusetts, USA, 18-24 Jun 1988).

An easy-to-use graphical design tool for stand-alone photovoltaic (PV)/storage systems has been developed. This design tool is intended for an audience with minimal technical knowledge or without access to a computer (as, for example, in remote areas of developing countries). By following a design worksheet with step-by-step calculations which incorporate design graphs, one can quickly size a stand-alone photovoltaic/storage system with a constant daily load for a specified loss-of-load probability (LOLP) and location. The design specifications obtained are: optimum tilt angle of the fixed array, and an array and storage size combination which will result in minimum cost. A method for estimating the uncertainty in the LOLP estimate due to limited historical insolation sample sizes was developed. The uncertainty, or confidence interval, becomes relatively large as the mean LOLP estimate drops below 0.01.

33402 A model for predicting the loss-of-load probability of stand-alone photovoltaic/storage systems with variable loads. Bloom, D.R. (Photovoltaic Program, Univ. of Lowell, One Univ. of Avenue, Lowell, MA (US)); Duffy, J.J. v.v of Solar '88 (Technical Papers). Coleman, M.J. American Solar Energy Society, Boulder, CO (1988). (CONF-880615–: Solar '88: American Solar Energy Society annual meeting and 13th national passive solar conference, Cambridge, Massachusetts, USA, 18-24 Jun 1988).

A model has been developed for predicting the steady-state loss-of-load probability (LOLP) for stand-alone photovoltaic (PV) systems with random loads. Horizontal daily insolation was treated as a stationary stochastic process with dependence on the previous day's value. The storage of the PV system was modeled as a discrete-time and discrete-state process. Comparisons to simulation results and other published results were used to help verify the model. Initial sensitivity analyses with uniformly distributed loads (based on actual data) indicate changes in long-term LOLP predictions compared to the fixed load case of more than 50%.

33403 Technology transfer in action. LaHart, D.E. (Technology Transfer Office, Florida Solar Energy Center, 300 State Road 401, Cape Canaveral, FL (US)); Ventre, G.G. v.v of Solar '88 (Technical Papers). Coleman, M.J. American Solar Energy Society, Boulder, CO (1988). (CONF-880615–: Solar '88: American Solar Energy Society annual meeting and 13th national passive solar conference, Cambridge, Massachusetts, USA, 18-24 Jun 1988).

The Florida Solar Energy Center (FSEC) has been actively involved with photovoltaic applications for over a decade. As an outgrowth of our many years of practical, hands-on experience with PV technology and technology transfer, the Governor's Energy Office and FSEC cooperatively developed the Photovoltaic System Design and Training Center (PVSDCT). The PVSDTC is specifically designed to serve the needs of Florida's growing PV industry, governmental agencies that use PV, and the general public. In addition, a special effort is made to include educators from public schools, community colleges, vocational training centers and universities. This paper provides information about the nature and scope of technology transfer, identifies the characteristics of a technology transfer program and describes FSEC's efforts to provide leadership and serve as a national model for education and training.

33404 SERI's photovoltaic research project. Surek, T. (Solar Energy Research Institute, 1617 Cole Boulevard, Golden, CO (US));

Basso, T.; McConnell, R.; Stone, J.; Witt, E. v.v of Solar '88 (Technical Papers). Coleman, M.J. American Solar Energy Society, Boulder, CO (1988). (CONF-880615–: Solar '88: American Solar Energy Society annual meeting and 13th national passive solar conference, Cambridge, Massachusetts, USA, 18-24 Jun 1988).

Photovoltaic (PV) research efforts at the Solar Energy Research Institute (SERI) provide the foundation for new PV technologies having lower cost, higher performance, and improved reliability when compared with today's PV technologies. This paper focuses on recent progress and future directions in PV research managed by SERI for the U.S. Department of Energy. The emphases of the research efforts are on single-junction and multijunction devices based on amorphous silicon and polycrystalline thin-film materials. Other areas of importance include high efficiency crystalline cells based on gallium arsenide and III-V alloys, and studies of crystalline silicon sheet materials. Improvements in materials and processing, solar cell design, and cell fabrication techniques have led to new records in cell efficiencies in nearly all material areas. Enhanced measurement and characterization techniques, along with increased interactions among PV scientists, are adding to a strong foundation for PV's future use.

33405 Two-stage electrical array reconfiguration controller for PV-powered water pump. Mulpur, A.K. (Dept. of Electrical Engineering, Univ. of Lowell, Lowell, MA (US)); Dagher, F.; Salameh, Z. v.v of Solar '88 (Technical Papers). Coleman, M.J. American Solar Energy Society, Boulder, CO (1988). (CONF-880615–: Solar '88: American Solar Energy Society annual meeting and 13th national passive solar conference, Cambridge, Massachusetts, USA, 18-24 Jun 1988).

This paper presents a technique to improve the performance of photovoltaic (PV) powered water pumps. The method uses a solid state, two-stage Electrical Array Reconfiguration Controller (EARC), which senses the radiation as high or low. The limit of each stage can be changed. Accordingly, the controller chooses one favorable set of V-I characteristics for starting and another favorable set of V-I characteristics for steady state operation. This is done by switching the solar panels, depending upon the starting current requirements and the insolation level, from a predominantly parallel connection to a predominantly series connection. The switching occurs at the end of the start-up of the motor. This produces a sufficient starting torque which considerably improves the pump's performance, particularly in the early morning, late evening and on cloudy days, providing valuable extra pumping hours for the user. The performance of a direct coupled system and a system equipped with a two-stage EARC is presented and compared.

33406 Approaching the irradiance of the surface of the sun. Gleckman, P. (Dept. of Physics and Enrico Fermi Institute, The Univ. of Chicago, Chicago, IL (US)); Winston, R.; O'Gallagher, J. v.v of Solar '88 (Technical Papers). Coleman, M.J. American Solar Energy Society, Boulder, CO (1988). (CONF-880615–: Solar '88: American Solar Energy Society annual meeting and 13th national passive solar conference, Cambridge, Massachusetts, USA, 18-24 Jun 1988).

Measurements are reported of the irradiance produced by a two-stage solar concentrator designed to approach the thermodynamic limit. Sunlight is collected by a 40.6 cm diameter parabolic primary which forms a .98 cm diameter image. The image is reconcentrated by a nonimaging refracting secondary with index n=1.53 to a final aperture 1.27 mm in diameter. Thus, the geometrical concentration ratio is 102,000. The highest irradiance value achieved was 4.4 $\pm$0.2kW cm^{-2}, or 56,000 $\pm$ 5,000 suns, relative to a solar disk insolation of 800 W m^{-2}. This is greater than the previous peak solar irradiance record by nearly a factor of three, and it is 68% of that existing at the solar surface itself. The efficiency with which the authors concentrated 55 W of sunlight to a small spot suggests that our two-stage system would be an excellent candidate for solar pumping of solid state lasers.

33407 Step-up maximum power point tracker for photovoltaic arrays. Salameh, Z. (Univ. of Lowell, Lowell, MA (US)); Taylor, D. v.v of Solar '88 (Technical Papers). Coleman, M.J. American Solar Energy Society, Boulder, CO (1988). (CONF-880615–: Solar '88: American Solar Energy Society annual meeting and 13th national passive solar conference, Cambridge, Massachusetts, USA, 18-24 Jun 1988).

This paper discusses a new maximum power point tracker (MPPT), which has been deviced and tested at the laboratory. This MPPT is a high frequency set-up DC to DC power conditioning unit. Simple and inexpensive analog circuitry is used to continually maximize the true PV array output power rather than maximizing the current or voltage at either the PV array or load. The control circuit is designed such that the actual current and voltage are sensed directly from the PV array. These two signals are then multiplied by a single chip multiplier.

1407 Solar Thermal Power Systems

Refer also to citation(s) 33417

33408 (SERI/TR–215-3323) **The impact of solar radiation resources on the siting of solar thermal power plants.** Maxwell, E.L.; Rymes, M.D. Solar Energy Research Inst., Golden, CO (USA). Dec 1988. 69p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract AC02-83CH10093. Order Number DE89000839/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

This report describes results of an effort to study the impact of solar radiation resources and enhance the use of solar radiation data for siting solar thermal power plants. This was a follow-on to an initial development of a siting methodology by the same authors. The work was done on a limited budget and does not constitute an actual power plant siting. Rather, these results demonstrate a methodology that incorporates various means for improving solar resource information and its use in identifying the best locations for power plants. These reports represent the first step in a technology transfer process that may lead to industrial applications of the methods described. The solar radiation characteristics must be analyzed further before accurate site selections and system designs can be made. 11 refs., 47 figs., 10 tabs.

33409 Status of TSC hybrid solar conversion in Illinois. Soule, D.E. (Western Illinois Univ., Macomb, IL (US)). v.v of Alternative energy in the Midwest. Illinois Dept. of Energy and Natural Resources, Springfield, IL (1987). (CONF-870366–: Alternative energy in the midwest: research and applications, Rosemont, Illinois, USA, 18-20 Mar 1987).

Technical Paper ILENR/AE-87/6.

Total solar cogeneration (TSC) is a photovoltaic-photothermal hybrid method for both optimizing the input solar conversion and the output cogeneration of power to produce high-grade heat (HT, 400^{0}C) for industrial/commercial process heat, low-grade heat (LT, 70^{0}C) for space/water heating, and electricity (PV, 150 W/module). Efficiency optimization studies of the transparent heat-mirror spectral profile give projected operating efficiencies of PV = 10%, HT = 3-%, and LT = 29%, with an overall efficiency of 69%. A full-scale module (1.5 m^2 clear aperture) with a 40x linear Fresnel lens concentrator is presently under construction and evaluation at Western Illinois University for seasonal testing on a flat-roof industrially simulated location.

33410 A review of the chemical and physical properties of molten alkali nitrate salts and their effect on materials used for solar central receivers. Bradshaw, R.W. (Sandia National Labs., Livermore, CA (US)); Carling, R.W. v.v of Proceedings of the Electrochemical Society Fall meeting: Extended abstracts. Volume 87-2. The Electrochemical Society, Pennington, NJ (1987). (CONF-871027–: 172. meeting of the Electrochemical Society, Honolulu, Hawaii, USA, 18-23 Oct 1987).

The results of a comprehensive research program that was established by Sandia National Laboratories to address issues relevant to the use of a molten mixture of $NaNO_3$ and KNO_3 at temperatures up to 600^{0}C for thermal energy collection and storage in solar central receivers (SCR) are reviewed. The selection of this type of molten salt was initially derived from a systematic screening process which identified several favorable characteristics, such as a low melting point (222^{0}C), the availability of large quantities at low cost, and the minimal hazards associated with its use. Although molten nitrate salts have been used extensively for heat transfer in industrial processes and compilations of some of their properties are available, the maximum temperature intended for SCR systems

is 600°C, which is significantly higher than previous applications. For this reason, a research program was undertaken to establish a data base describing the properties of a molten mixture of $NaNO_3$ and KNO_3 over the complete range of temperatures relevant to advanced SCRs. The program included studies of chemical stability, physical properties, corrosion of metallic materials, environmental effects on the mechanical properties of alloys, and compatibility of non-metallic materials with the molten salt. A comprehensive group of studies has been completed and the results summarized. The topics investigated concerning the chemical properties of molten nitrate salt mixtures were verifying the phase diagram, determining chemical stability, analyzing the effects of cover gas composition and atmospheric contamination on the melt and assessing hazards.

1409 Solar Thermal Utilization

Refer also to citation(s) 33743

33411 A decade of progress in the use of solar energy for buildings. Morse, F.H. (Office of Solar Heat Technologies, U.S. Dept. of Energy, 1000 Independence Ave., Washington, DC (US)). v.v of Solar '88 (Technical Papers). Coleman, M.J. American Solar Energy Society, Boulder, CO (1988). (CONF-880615–: Solar '88: American Solar Energy Society annual meeting and 13th national passive solar conference, Cambridge, Massachusetts, USA, 18-24 Jun 1988).

Today, solar heating and hot water systems are commercially available in every IEA country: from passive heated homes in England, to a large agricultural water heating application in the Netherlands; from domestic water heating in Canada, to the solar heating and cooling of an office building in Japan; from homes heated via passive solar in Austria, to large-scale water heating systems in Spain and the United States. Ten years ago, this technology was not available on any commercial scale, except in a few countries such as Australia and Israel. The dramatic and important progress made in solar heating during this past decade was due, in part, to the results of the International Energy Agency (IEA) Solar Heating and Cooling Program. Together with the national programs within the IEA countries, this international research program has made important contributions towards identifying and resolving the major problems which blocked this technology.

33412 Radon-222 reduction in solar buildings through pressurization. Boardman, C.R. (Dept. of Mechanical Engineering, Colorado State Univ., Fort Collins, CO (US)); Kirkpatrick, A.T. v.v of Solar '88 (Technical Papers). Coleman, M.J. American Solar Energy Society, Boulder, CO (1988). (CONF-880615–: Solar '88: American Solar Energy Society annual meeting and 13th national passive solar conference, Cambridge, Massachusetts, USA, 18-24 Jun 1988).

Indoor air quality can be a problem in energy conserving houses. The Reconfigurable Passive Evaluation Analysis and Test (REPEAT)facility at Colorado State University was an extreme case as the radon-222 levels have been as high as 660 pCi 1^{-1} (mean 310). Radon mitigation activities, which included sealing the floor and pressurizing the building to control radon infiltration from the soil, reduced the radon to background levels (4 pCi 1^{-1}). This pressurization technique, which stops the stack effect driven radon entry and also supplies fresh air to the building, deserves more attention in helping to solve difficult radon problems in energy conserving homes.

33413 Lessons learned from the 10,000 square foot evacuated tube solar energy system on the Illinois Department of Agriculture building. Newell, T.A. (Univ. of Illinois at Urbana-Champaign, Urbana, IL (US)); Cowie, R.G.; Langley, T.L. v.v of Alternative energy in the Midwest. Illinois Dept. of Energy and Natural Resources, Springfield, IL (1987). (CONF-870366–: Alternative energy in the midwest: research and applications, Rosemont, Illinois, USA, 18-20 Mar 1987).

Technical Paper ILENR/AE-87/6.

Several aspects of the Illinois Department of Agriculture Building's large scale solar energy collector system are described. A microcomputer-based datalogging system has been installed for maintenance and economic performance analyses. The most serious problem has been extensive breakage of the evacuated tubes. Other miscellaneous problems have also occurred and are described.

33414 Alternative methods for short-term field monitoring of active solar domestic hot water systems. Christensen, C. (Solar Energy Research Institute, Golden, CO (US)); Sakuta, K. v.v of Solar '88 (Technical Papers). Coleman, M.J. American Solar Energy Society, Boulder, CO (1988). (CONF-880615–: Solar '88: American Solar Energy Society annual meeting and 13th national passive solar conference, Cambridge, Massachusetts, USA, 18-24 Jun 1988).

Theoretical aspects of short-term monitoring of installed active solar water heating systems with well-mixed storage are discussed. Previously proposed methods and new, more general methods are compared in terms of test protocols and energy balance equations. Issues discussed include: potential problems with simultaneous parameter estimation, the feasibility of nighttime testing, and difficulties in measurement of the rate of change of storage tank temperature.

1410 Solar Collectors and Concentrators

Refer also to citation(s) 33139, 33398, 33961, 33962, 34029

33415 Nonimaging optical concentrators in photovoltaics. Ning, X. (Univ. of Chicago, Chicago, IL (US)). v.v of Alternative energy in the Midwest. Illinois Dept. of Energy and Natural Resources, Springfield, IL (1987). (CONF-870366–: Alternative energy in the midwest: research and applications, Rosemont, Illinois, USA, 18-20 Mar 1987).

Technical Paper ILENR/AE-87/6.

High concentration optics, when used in conjunction with high efficiency solar cells offers a very promising path for economic conversion of sunlight to electricity. However, most conventional systems (i.e. Fresnel lenses) require very accurate tracking because of their small angular acceptances. And it is also difficult to achieve high concentration with fresnel lenses. The authors are developing a new family of optical concentrators which overcome these difficulties. These concentrators using fresnel lenses as the primary focusing devices and nonimaging optical concentrators as the secondary devices can achieve both larger angular acceptances and high concentrations. Therefore the costs of precise tracking and the solar cells are reduced. Preliminary research has already shown the technical feasibility of this approach.

33416 Performance sensitivities for point-focus dish systems with secondary concentrators. Lewandowski, A. (Thermal Systems Research Branch, Solar Energy Research Institute, Golden, CO (US)); O'Gallagher, J. v.v of Solar '88 (Technical Papers). Coleman, M.J. American Solar Energy Society, Boulder, CO (1988). (CONF-880615–: Solar '88: American Solar Energy Society annual meeting and 13th national passive solar conference, Cambridge, Massachusetts, USA, 18-24 Jun 1988).

This paper describes an analytical study of several performance-related benefits of using a secondary concentrator in point-focus dish designs. Previous research efforts have shown that design-point performance of dishes can be improved with secondary concentrators, especially for dishes with higher optical errors or at higher receiver operating temperatures. This work addresses the sensitivity to changes in design-point parameter values corresponding to both tracking and optical errors. An analytical model and a ray-trace model were used in analyzing these sensitivities. Results indicate that properly designed secondaries can significantly increase the tolerance to tracking errors and decrease the sensitivity to changes in optical errors from design-point values. Two approaches are recommended on which to base the design of the secondary.

33417 Applications of nonimaging secondaries with stressed membrane primary concentrators. O'Gallagher, J. (The Enrico Fermi Institute, The Univ. of Chicago, Chicago, IL (US)); Winston, R.; Lewandowski, A. v.v of Solar '88 (Technical Papers). Coleman, M.J. American Solar Energy Society, Boulder, CO (1988). (CONF-880615–: Solar '88: American Solar Energy Society annual meeting and 13th national passive solar conference, Cambridge, Massachusetts, USA, 18-24 Jun 1988).

Two-stage maximally concentrating optical configurations have been shown to have significant advantages for solar thermal applications. These systems consist of a point focus primary combined

with an optimized nonimaging secondary of the CPC or trumpet type. A comprehensive optical and thermal model for their analysis has been developed which uses a computer ray trace to determine the distribution of concentrated flux in the focal plane and optimizes the trade-off between heat losses and optical intercept both with and without a secondary. Other features of this model include a procedure for tracing the complete focal plane optical distribution through any specified trumpet geometry and a new procedure for tracing rays reflected off surfaces whose radial profile is a generalized shape defined by discreet point co-ordinates, for example, such as might be generated by a structural analysis code.

33418 Systems and applications development for integrated evacuated CPC collectors. O'Gallagher, J. (The Univ. of Chicago, Chicago, IL (US)); Winston, R.; Schertz, W.; Bellows, A. v.v of Solar '88 (Technical Papers). Coleman, M.J. American Solar Energy Society, Boulder, CO (1988). (CONF-880615--: Solar '88: American Solar Energy Society annual meeting and 13th national passive solar conference, Cambridge, Massachusetts, USA, 18-24 Jun 1988).

To date the Integrated Compound Parabolic Concentrator (ICPC) has remained a highly successful experimental concept which has demonstrated that very efficient high temperature performance from fixed non-tracking concentrators is a technical reality. However, because of its great flexibility and compatibility with a wide range of applications, it has the potential to become the general purpose solar thermal collector for the future. Several studies are now underway with the objectives of overcoming the remaining technical and practical barriers. One proposed design uses a large diameter (125mm) borosilicate glass tube with a specially configured internal shaped mirror CPC coupled to a U-tube absorber. Another is scaled to be compatible with the use of presently available fluorescent glass tubing and production tooling. The authors review these designs and their advantages and suggest two specific examples of new systems applications which provide particularly dramatic illustrations of the potential for these unique collectors for broadening the market for solar thermal energy in the future.

33419 Dielectric compound parabolic concentrating solar collector with frustrated total internal reflection absorber. Hull, J.R. (Argonne National Lab., Argonne, IL (US)). v.v of Solar '88 (Technical Papers). Coleman, M.J. American Solar Energy Society, Boulder, CO (1988). (CONF-880615--: Solar '88: American Solar Energy Society annual meeting and 13th national passive solar conference, Cambridge, Massachusetts, USA, 18-24 Jun 1988).

Coupling a dielectric compound parabolic concentrator (DCPC) to an absorber across a vacuum gap by means of frustrated total internal reflection (FTIR) can theoretically approach the maximum concentration permitted by physical laws, thus allowing higher radiative fluxes in thermal applications. The calculated optical performance of two-dimensional DCPCs with FTIR absorbers indicates that the ratio of gap thickness to optical wavelength must be less than 0.22 before the optical performance of the DCPC is superior to that of the nondielectric CPC.

33420 Thermal modeling of evacuated tubular collectors. Barrett, A.L. (Solar Energy Lab., Univ. of Wisconsin, Madison, WI (US)); Beckman, W.A.; Duffie, J.A. v.v of Solar '88 (Technical Papers). Coleman, M.J. American Solar Energy Society, Boulder, CO (1988). (CONF-880615--: Solar '88: American Solar Energy Society annual meeting and 13th national passive solar conference, Cambridge, Massachusetts, USA, 18-24 Jun 1988).

An evacuated tubular collector (ETC) differs from the more common flat-plate collector in geometry, heat loss characteristics, and capacitance. In this paper, the effects of these differences on performance calculations are studied. Computed results are compared to measured performance data for two large ETC systems. Based on these comparisons, improvements to traditional collector modeling to best simulate ETCs are suggested.

1420 Heat Storage

Refer also to citation(s) 33414, 33650

33421 (ITL–8509, pp. 245-248) **The Suncourt project.** Hyden, H. (Swedish Consulting Group, Stockholm, Sweden); Kellner, J. Intertask Ltd., Ottawa, ON (Canada). 1985. (In English and French). (CONF-850905--: ENERSTOCK '85 - international conference on energy storage for building heating and cooling, Toronto, Canada, 22-26 Sep 1985;MICROLOG–89-00267). In *Enerstock 85. 3rd International conference on energy storage for building heating and cooling. Proceedings.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, Canada K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The Suncourt project is a low-energy block of flats now under construction in Stockholm. The anticipated demand for external energy is one third that of a conventional new building. The basic feature of the building is a glazed-in courtyard which, from an energy point of view, serves as a solar collector. The excess heat from the court is stored in a seasonal heat storage under the building with the help of a heat pump. The storage is a so-called drillhole storage in the rock, comprising 25 holes drilled to a depth of 80 m. The storage serves as a heat source for the heat pump during the winter. The residents will be able to move into the new building by the end of 1985. 4 figs.

15 GEOTHERMAL ENERGY

1501 Resource Status and Assessment

33422 (DOE/ID/10333–T1) **A national strategy for the export of US geothermal technology.** Technology Prospects, Inc., Falls Church, VA (USA). Mar 1989. 28p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract AP07-89ID10333. Order Number DE89012649/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This document presents a proposal for an explicit US strategy to focus this still diffuse interest into a coordinated effort by the public and private sectors to increase exports of US geothermal goods and services over the next five to ten years. This document summarizes the background and need for an explicit US strategy, the factors influencing the development of this strategy, strategy options, and a recommended strategy.

1502 Geology and Hydrology of Geothermal Systems

Refer also to citation(s) 33598

1503 Geothermal Exploration and Exploration Technology

33423 (LBL–25971) **Some design considerations for the proposed Dixie Valley tracer test.** Doughty, C.; Bodvarsson, G.S. Lawrence Berkeley Lab., CA (USA). Jun 1988. 17p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract AC03-76SF00098. Order Number DE89012850/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A tracer test for the Dixie Valley, Nevada, geothermal resource is planned for the summer of 1988, in order to study the fluid flow paths that will develop under typical operating conditions. During the test six production wells will provide the power plant with steam sufficient for generation of 60 MWe, requiring fluid production at a rate of approximately 600 kg/sec. Up to 75% by mass of the extracted fluid will be reinjected into the reservoir, using four injection wells. Tracer will be added to the injected fluid for a twenty-minute period, and subsequently the produced fluid will be monitored for the tracer. 5 refs., 9 figs., 5 tabs.

33424 Field applications of fiber-optic sensors. Part I: Temperature measurements in a geothermal well. Angel, S. M. (Environmental Sciences Division, Lawrence Livermore National Laboratory, Livermore, California 94550 (S.M.A., D.G.G.)); Garvis, D. G.; Sharma, S. K.; Seki, A. *Applied Spectroscopy (USA)*, 43(3): 430-434 (Mar 1989). DOE Contract W-7405-ENG-48.

We have initiated a program for developing and field testing fiber-optics-based sensors to monitor *in situ* physical and chemical

parameters in highly corrosive environments, such as geothermal wells, oil wells, and hot-water boiler reactors. Inability to sample hot geothermal wells or to measure the chemical composition of hot brines limits our understanding of *in situ* conditions in geothermal fields. In this communication, we report preliminary results obtained with a temperature optrode to profile the temperature in a geothermal steam well. To our best knowledge, this is the first time *in situ* geothermal well measurements have been made with the use of a fiber-optic sensor.

1509 Geothermal Engineering

33425 (LBL–25635) **Proceedings of the technical review on advances in geothermal reservoir technology—Research in progress.** Lippmann, M.J. (ed.). Lawrence Berkeley Lab., CA (USA). Sep 1988. 141p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract AC03-76SF00098. (CONF-8806367–: Technical review on advances in geothermal reservoir technology: research in progress, Berkeley, California, USA, 14-15 Jun 1988). Order Number DE89013358/JAW. Available from NTIS, PC A07/MF A01 - OSTI; GPO Dep.

This proceedings contains 20 technical papers and abstracts describing most of the research activities funded by the Department of Energy (DOE's) Geothermal Reservoir Technology Program, which is under the management of Marshall Reed. The meeting was organized in response to several requests made by geothermal industry representatives who wanted to learn more about technical details of the projects supported by the DOE program. Also, this gives them an opportunity to personally discuss research topics with colleagues in the national laboratories and universities.

33426 (LBL–26819) **The hydrogeologic-geochemical model of Cerro Prieto revisited.** Lippmann, M.J.; Halfman, S.E.; Truesdell, A.H.; Manon M., A. Lawrence Berkeley Lab., CA (USA). 1989. 12p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract AC03-76SF00098. (CONF-890114–5: 14. workshop on geothermal reservoir engineering, Stanford, California, USA, 24-26 Jan 1989). Order Number DE89012993/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

As the exploitation of the Cerro Prieto, Mexico, geothermal field continues, there is increasing evidence that the hydrogeologic model developed by Halfman et al. (1984, 1986) presents the basic features controlling the movement of geothermal fluids in the system. At the present time the total installed capacity at Cerro Prieto is 620 MWe requiring the production of more than 10,500 tonnes/hr of a brine-steam mixture. This significant rate of fluid production has resulted in changes in reservoir thermodynamic conditions and in the chemistry of the produced fluids. After reviewing the hydrogeologic-geochemical model of Cerro Prieto, some of the changes observed in the field due to its exploitation are discussed and interpreted on the basis of the model. 21 refs., 11 figs., 1 tab.

1520 Geothermal Data and Theory

Refer also to citation(s) 33425

17 WIND ENERGY

33427 (SERI/SP–220-3486) **Wind Power: Today's energy option.** Solar Energy Research Inst., Golden, CO (USA). Apr 1989. 16p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract AC02-83CH10093. Order Number DE89000876/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This report is an overview of the current state of wind power programs. In addition to technical briefs, the report contains program management summaries and future goals of the wind power industry. (JF)

1706 Wind Energy Engineering

Refer also to citation(s) 33354

33428 (ECN–89-057) **Analysis of the performance of the passively controlled blade tips of the Flexhat concept 'Tip control 1'.** Lindenburg, C. Netherlands Energy Research Foundation, Petten (Netherlands). Mar 1989. 28p. (In Dutch). Available from Netherlands Energy Research Foundation ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

Within the Flexhat project research is carried out on the performance of wind turbine rotors by means of advanced concepts. One of these concepts are the passively controlled blade tips. The purpose of these tips is to diminish fluctuations of the wind turbine speed which can be caused by wind velocity variations. The so-called 'Regeltip 1' (Tip control 1) configuration is described. Results of computerized calculations, by means of the computer program PHATAS-II, on the configuration are presented. The aim of the calculations is to provide information on the control behavior of this concept at different wind velocities, different frictions and when the wind turbine is turned out of the wind. 9 figs., 2 refs., 1 tab.

20 ELECTRIC POWER ENGINEERING

33429 (OH/RD–634G568) **Steam turbine blading repair. Phase 1.** Munro, C. Ontario Hydro Research Div., Toronto, ON (Canada). 1988. V (CE–02605). Available from Canadian Electrical Association, Research & Development, Suite #500, One Westmount Square, Montreal, PQ, Canada H3Z 2P9; $75.00 NON-MEMBERS; MEMBERS: PRICES UPON REQUEST, FUNDS CAN.

The objective of the project was to examine the options that are available to a utility when faced with a cracked low pressure turbine rotating blade. The study was broken into two distinct phases. The Phase 1 effort, which is the subject of this report, identifies what repairs are being effected and by whom. The risk analysis required to arrive at a decision to either repair or replace or remove is presented. The following conclusions were made: there is a utility interest in having the ability to make blade repair decisions; the manufacturers did not express a willingness to divulge specific weld repair procedures; and although the occasions for repair decision of this nature are relatively few, there is a significant potential cost advantage in being able to perform in-situ repairs. The outcome is a recommendation to proceed with the Phase 2 program of developing welding technology and procedures for this situation. 21 refs., 8 figs., 1 tab.

2001 Power Plants and Power Generation

Refer also to citation(s) 33103, 33137, 33141, 33142, 33189, 33445, 33624, 33625, 33637, 33665, 34209

33430 (DOE/PC/88750–T1) **TRW advanced slagging coal combustor utility demonstration: First quarterly project progress report, October 1988–January 1989.** TRW Energy Products Group, Redondo Beach, CA (USA). Combustion Business Unit. 1989. 19p. Sponsored by DOE Fossil Energy. DOE Contract FC22-89PC88750. Order Number DE89011367/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The TRW Advanced Slagging Coal Combustor Demonstration Project consists of retrofitting the Orange and Rockland (O and R) Utility Corp. Lovett Plant Unit No. 3 with four slagging combustors which will allow the current gas/oil fired unit to fire 2.5% sulfur coal. The slagging combustor process will provide NO_x and SO_x emissions that meet NSPS and New York State environmental standards. During this reporting period, SWEC set up and implemented the programs to perform budgeting, cost and scheduling, engineering, design, purchasing and general administration of the project. These programs were reviewed and approved by TRW-UDU and O and R. SWEC also issued a draft of the Project Manual to TRW and O and R for review and comment. SWEC also issued specifications for the inspection of existing equipment to assess the condition and the requirements for refurbishing this equipment.

33431 (ESC-WR–89-05) **Starting points and user manual for a heat chart model. Model development for heat technical calculations of, among other things, cogeneration options.** Van Wees, F.G. Stichting Energieonderzoek Centrum Nederland, Petten (Netherlands). Energie Studie Centrum. Apr 1989. 36p. (In Dutch).

Available from Netherlands Energy Research Foundation ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

For the benefit of the project GEIN (Large-scale Industrial Power Generation) several steam generation options have been calculated for energy-technical aspects by means of a DOW Chemical Netherlands developed computerized calculation program. The now developed cogeneration model concerns an adjusted version aimed at supporting the DATAMAN-project. The DATAMAN-project is meant to build an information system to compile data which are important for ESC studies (ESC is the Energy Study Centre of the Netherlands Energy Research Foundation). Starting points and values as stated in the GEIN-study form the basis of this report. Also the adjustments for the cogeneration model are indicated. The applicated calculation methods for thermodynamical calculations are outlined. The user manual describes the model possibilities to acquire calculation results for a heat and power generating installation: power capacity, fuel consumption and three indicators for cogeneration units are discussed. 7 figs., 3 tabs., 3 apps.

33432 (ETY–22/1989) **Maintance system of heating plants.** Seppaelae, R.; Pekkala, R. Finnish Energy Economy Association, Helsinki (Finland). Mar 1989. 64p. (In Finnish). Order Number DE89776170/JAW. Available from NTIS (US Sales Only), PC A04/MF A01;1.

In this project the present status of maintenance in heating plants was studied and development plans and a suggestion for applying EDP to the maintenance operations were made. Instructions and models for the development of maintenance will be given in the final report. The plants which participated in this project were small heating plants in rural areas, heating companies in cities and one large local energy board and one power plant. The result of the survey was that the level of planning in the plants is fairly low and their data management equipment is undeveloped. Developing the maintenance operations of the plants should be focused on the following areas: improving the availability and reliability of maintenance databases; improving preventive maintenance, storage facilities administration and revision system; preparing written instructions for the tasks and intensifying short-term planning and the use of EDP and software packages. Models for maintenance planning in investment projects of the plants should be made. Maintenance data management instructions, model forms and the method of handling them were presented in the project. Small plants shall develop their maintenance operations with manual systems. In larger plants the use of EDP can be justified. During the project the maintenance programs have developed to a level where it is possible to provide all plants, expect the smallest ones, with maintenance software.

33433 (ORNL/Sub–87-86004/5) **Energy Economic Data Base (EEDB) Program: Phase 9 Update (1987) report, AGCC5-A supplement: Advanced gas turbine combined cycle (natural gas based) power generating station.** Oak Ridge National Lab., TN (USA); United Engineers and Constructors, Inc., Philadelphia, PA (USA). May 1989. 120p. Sponsored by DOE Management & Administration. DOE Contract AC05-84OR21400. Order Number DE89013733/JAW. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

The purpose of this AGCC5-A supplement is to identify direct equipment, material and labor costs, and indirect costs in sufficient detail to be used as a baseline for comparing the costs of combined-cycle gas-fired power plants with the costs of alternatives. This information is needed to satisfy the cost evaluation requirements of the Oak Ridge National Laboratory (ORNL) and the US Department of Energy (DOE). 11 refs., 9 figs., 15 tabs.

33434 (SVF–323) **Operating experience of fluidized-bed boilers.** Sparre, C. Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden). Nov 1988. 44p. (In Swedish). Order Number DE89776247/JAW. Available from NTIS (US Sales Only), PC A03/MF A01;1.

Two bubbling beds from 1982 and 1984 and three circulating fluidized beds from 1982 and 1985 have been studied. The bubbling beds (SFB) have rather good emission levels (CO and NO_x). The studied plants could be compared with similar modern grateboilers. The availability is close to 100% if clean fuels are used and a general revision is made during the summerstop. When refuse fuels are used it is necessary to make planned stops for cleaning and service even during the working season. The availability is then around 97% during this season. If coals or refuse fuels are used some parts of the plant will have a limited life. The circulating beds (CFB) are easier to control. They have also better emission values. Besides low CO- and NO_x-values, SO_x can be reduced by 75% with a Ca/S value as low as 1.5. Erosion problems are overcome by studding, metal coating, protecting blocks, refractory or diverting devices. This thick refractory in the sand separating cyclones cause some times long start-up times (48 hours) or low availability. Pieces of refractory have caused stops by blocking the holes to the furnace. The availability of the two district heating boilers was of this reason as low as 93%. The industrial boiler had a higher value (98%). The handling equipments were sensible to impurities in fuels and ashes. Traditional minor problems and wear have also caused many problems.

33435 **Biological effects of spark-decomposed SF_6.** Griffin, G.D. (Health and Safety Research Div., Oak Ridge National Lab., P.O. Box 2008, Oak Ridge, TN (US)); Nolan, M.G.; Easterly, C.E.; Sauers, I. v.v of Proceedings of the Electrochemical Society fall meeting. Volume 88-2 (extended abstracts). The Electrochemical Society, Pennington, NJ (1988). (CONF-881061–: Electrochemical Society fall meeting, Chicago, Illinois, USA, 9-14 Oct 1988).

Sulfur hexafluoride (SF_6) is widely used as an insulating gas in electrical applications, such as GIS (gas-insulated substations), switchgear, etc. The gas is chemically inert and biologically innocuous. Depending upon conditions of electrical discharge (arc, sparks, corona), presence of other chemical compounds in the SF_6 gas (e.g., H_2O), composition of electrode materials, and other factors, a variety of different chemical species may arise following electrical stress. The authors have investigated decomposition of SF_6 during repeated sparking. The apparatus in which the sparking took place had a concentric cylindrical stainless steel electrode arrangement, and the total deposited energy was usually in the range of 1-32kJ. The various gaseous byproducts were analyzed by mass spectrometry or, in a few cases, gas chromatography.

33436 **An enhanced LQ adaptive VAR unit controller for power system damping.** Smith, J.R. (Electrical Engineering Dept., Montana State Univ., Bozeman, MT (US)); Pierre, D.A.; Rudberg, D.A.; Sadighi, I.; Johnson, A.P.; Hauer, J.F. *IEEE Transactions on Power Systems (USA)*, 4(2): 443-451 (May 1989).

This paper presents an adaptive LOG control strategy for static VAR compensators to enhance power system damping and stability. The control strategy utilizes only local information to dampen oscillatory modes present in the network. The controller calculates an appropriate value of SVC susceptance to present to the network at each sampling interval based on a reduced-order model of the power system. The reduced-order model is obtained on-line by a least squares identifier. Simulation results for a nine bus network are presented.

2002 Environmental Control Technology

Refer also to citation(s) 33957, 34385

33437 (DOE/PC/81002–T20) **Microwave energy for SO_2 and NO_x removal from flue gas: Final report.** Helfritch, D.J.; Feldman, P.L.; Efthimion, P.C.; McNeill, D.H. Cottrell Environmental Sciences, Somerville, NJ (USA). Sep 1987. 68p. Sponsored by DOE Fossil Energy. DOE Contract AC22-85PC81002. Order Number DE89007186/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

The objective of this program was to determine the effectiveness of the use of a microwave discharge for the removal of SO_2 and NO_x from flue gas. Within a microwave discharge, electrons are accelerated by the microwave field and achieve energies sufficient to ionize gas molecules. Subsequent recombination of ions results in the production of atoms and radicals which can react with SO_2 and NO_x. A laboratory scale experiment was undertaken to investigate this concept. Flue gas was generated by a propane fired boiler. SO_2 and NO_x were added from bottled sources to yield concentrations typical of coal combustion flue gas. Discharges were generated within metallic cavities of dimensions that rendered them to the microwave power that was directed into them. The gas was chemically analyzed downstream of the microwave discharge to determine the

degree of reaction with SO_2 and NO_x. Three resonant cavity designs were tested. Each new cavity was constructed in an effort to improve upon the results achieved with the previous cavity design. The first two cavities were designed such that the flue gas passed through the cavity and the discharge. The third cavity was designed to produce a discharge in a flow of steam, which was subsequently injected into the flue gas. The objective was the production of radical species to react with SO_2 and NO_x without the counterproductive creation of NO by the discharge. 17 refs., 26 figs.

33438 (DOE/PC/81012–T1-Pt.1-B) **5-MW Toronto HALT [Hydrate Addition at Low Temperature] pilot plant testing: Appendices: Part 1-B.** Babu, M.; College, J.; Forsythe, R.; Lee, K.; Herbert, R.; Kanary, D. Dravo Lime Co., Pittsburgh, PA (USA). Dec 1988. 115p. Sponsored by DOE Fossil Energy. DOE Contract AC22-85PC81012. Order Number DE89012482/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

"Hydrate Addition at Low Temperature" or HALT is a dry calcium-based hydrate injection process for the removal of SO_2 from flue gases off a sulfur bearing fuel. In this process the hydrate is pneumatically conveyed and injected into the flue gas stream as a dry particulate. The flue gas is cooled downstream of the hydrate injection location by spraying the gas with a stream of finely atomized water droplets. The water is atomized into a fine spray mist by using air under pressure as the atomizing fluid. The waste product from this process is the dry disposable solids which differ considerably from the wet cake solids obtained from a wet FGD process. This report contains appendices of pilot plant testing in the following areas: (a) figures (data as collected at 10 minute intervals), and inlet SO_2, O_2, and gas temperature variations, (b) raw data (sample), (c) solids analysis (hydrate, baghouse solids, and ESP Solids), (d) selected analytical methods on (1) microtrac procedure, (2) BET surface area measurement, (3) DuPont photometric SO_2 analyzer, and (e) corrosion test data.

33439 (DOE/PC/81012–T1-Pt.3) **ESP [electrostatic precipitator] tests at Toronto: Test results: Part 3.** Gooch, J.; Beittel, R.; DuBard, J.; Marchant, G. Jr. Dravo Lime Co., Pittsburgh, PA (USA). Dec 1988. 86p. Sponsored by DOE Fossil Energy. DOE Contract AC22-85PC81012. Order Number DE89012530/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

"Hydrate Addition at Low Temperature" or HALT is a dry calcium-based hydrate injection process for the removal of SO_2 from flue gases off a sulfur bearing fuel. In this process the hydrate is pneumatically conveyed and injected into the flue gas stream as a dry particulate. The flue gas is cooled downstream of the hydrate injection location by spraying the gas with a stream of finely atomized water droplets. The flue gas is cooled to as low a temperature as possible by spraying water on it, maintaining an approach to saturation temperature of 20°F or higher. Temperatures lower than this could cause potential problems with moisture condensation on cold duct walls, the particulate removal devices as ESP/baghouse. The waste product from this process is the dry disposable solids which differed considerably from the wet cake solids obtained from a wet FGD process. Tests performed on the electrostatic precipitator are described. The primary tasks performed were: (1) measurement of the particle size distribution, resistivity, and mass concentration of the fly ash or ash-sorbent mixture entering the ESP, (2) measurement of the collection efficiency of the ESP, (3) recording the electrical operating conditions and the voltage-current characteristics of the ESP, and (4) determination of the utilization of sorbent entering the ESP, and the additional utilization/SO_2 removal occurring within the precipitator. Chemical analyses were performed on fly ash and ash-sorbent mixtures. 30 figs., 22 tabs.

33440 (DOE/PC/81012–T1-Pt.4) **Multi-nozzle humidification tests: Test results: Part 4.** Stouffer, M. Dravo Lime Co., Pittsburgh, PA (USA). Dec 1988. 105p. Sponsored by DOE Fossil Energy. DOE Contract AC22-85PC81012. Order Number DE89012529/JAW. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

"Hydrate Addition at Low Temperature" or HALT is a dry calcium-based hydrate injection process for the removal of SO_2 from flue gases off a sulfur bearing fuel. In this process the hydrate is pneumatically conveyed and injected into the flue gas stream as a dry particulate. The flue gas is cooled downstream of the hydrate injection by spraying the gas with a stream of finely atomized water droplets. The water is atomized into a fine spray by using air under pressure as the atomizing fluid. The spray nozzles are specially designed. Results are presented on nozzle array field tests conducted using the Dravo HALT unit at Ohio Edison's Toronto station. A method for humidifier scale-up from single-nozzle pilot test data was demonstrated. The method uses arrays of nozzles, with each individual nozzle operated at fixed conditions determined as optimum in the single-nozzle tests. By applying this method, the Consol 8.3-inch pilot humidifier operation with a single Spraying Systems 1/8JJ-J12 nozzle was successfully scaled up to operation of the Dravo 31 x 31-inch humidifier with arrays of up to 46 J12 nozzles. The tests provided data on nozzle deposition and solids dropout that may be useful for large-scale humidifier design. 4 refs., 16 figs., 10 tabs.

33441 (DOE/PC/81012–T1-Pt.5) **Conceptual HALT [Hydrate Addition at Low Temperature] scaleup design: Capital and operating costs: Part 5.** Babu, M.; Kerivan, D.; Hendrick, C.; Kosek, B.; Tackett, D.; Golightley, M. Dravo Lime Co., Pittsburgh, PA (USA). Dec 1988. 211p. Sponsored by DOE Fossil Energy. DOE Contract AC22-85PC81012. Order Number DE89011870/JAW. Available from NTIS, PC A10/MF A01 - OSTI.

Hydrate addition at low temperature (or the HALT process) is a retrofit option for moderate SO_2 removal efficiency in coal burning utility plants. This dry FGD process involves injecting calcium based dry hydrate particles into flue gas ducting downstream of the air preheater where the flue gas temperature is typically in the range of 280-325°F. This report is comprised of the conceptual scaleup design of the HALT process to a 180 MW and a 500 MW coal fired utility station followed by detailed capital and operating cost estimates. A cost sensitivity analysis of major process variables for the 500 MW unit is also included. 1 fig.

33442 (EPRI-CS–3862-Vol.4) **Arapahoe low-sulfur-coal Fabric Filter Pilot Plant: Volume 4, Shake-deflate cleaning tests, May 1984–July 1986: Final report.** Cushing, K.M.; Bustard, C.J.; Smith, W.B. Electric Power Research Inst., Palo Alto, CA (USA); Southern Research Inst., Birmingham, AL (USA). c Jun 1989. 71p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

This report describes operations at EPRI's low-sulfur coal Fabric Filter Pilot Plant during a twenty-seven month evaluation of shake-deflate cleaning. The primary objective was to collect sufficient data to optimize shake-deflate parameters and to allow prediction of baghouses operation with this cleaning method at utility power plants burning low-sulfur coal. The tests evaluated baghouse performance (pressure drop at various filtering air-to-cloth ratios, dustcake weight, and emissions) as a function of bag-cap acceleration, shake frequency, shake duration, and deflation volume. The findings indicate that shake-deflate cleaning can reduce cake weight and tube-sheet pressure drops by greater than 50% over conventional reverse-gas cleaned units. No bag life problems were observed over 11,000 h of testing, and emissions were very low (0.006 lb/10^6 Btu). Minimum filter pressure drop was attained at a bag-cap acceleration of 1.4 g (amplitude 2 in. and frequency 3 Hz). Low frequency high-amplitude shaking was more effective than high-frequency low-amplitude shaking. Shake durations around 20 s (at 3 Hz) preceded by deflation flows equivalent to about one-sixth total bag volume (1 ft/min deflation flow for 3 s) gave optimal performance. 9 refs., 12 figs., 5 tabs.

33443 (EPRI-GS–6396-Vol.1) **Causes of FGD [flue gas desulfurization] construction material failures: Volume 1, September 1982–July 1985: Final report.** Ellis, P.F. II; Anliker, D.M.; Jones, G.D. Electric Power Research Inst., Palo Alto, CA (USA); Radian Corp., Austin, TX (USA). c Jun 1989. 411p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto CA 94303.

Corrosion of flue gas desulfurization (FGD) systems causes significant reliability problems and costs utilities money. This report documents results of rigorous failure analysis of ten wet FGD system components, providing information helpful in solving existing problems, designing new plants, and defining research needs. The ten case histories discussed include rubber and organic linings, and metallic components. In these investigations, most failures of rubber and organic resin linings resulted from inherent materials limitations,

not improper application. This volume (Volume 1) contains case histories of investigations conducted between September 1982 and July 1985, as well as general conclusions reached as of July 1985.

33444 (EPRI-GS-6396-Vol.2) **Causes of FGD [flue gas desulfurization] construction material failures: Volume 2, August 1985–December 1986: Final report.** Ellis, P.F. II; Anliker, D.M.; Jones, G.D. Electric Power Research Inst., Palo Alto, CA (USA); Radian Corp., Austin, TX (USA). c Jun 1989. 295p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Corrosion of flue gas desulfurization (FGD) systems causes significant reliability problems and costs utilities money. This report documents results of rigorous failure analysis of ten FGD system components, providing information helpful in solving existing problems, designing new plants, and defining research needs. The seven case histories discussed include rubber and organic linings and metallic components. In these investigations, most failures of rubber and organic resin linings resulted from inherent materials limitations, not improper application. Volume 1 contains case histories of investigations conducted between September 1982 and July 1985, and general conclusions reached as of July 1985. This volume (Volume 2) presents case histories of investigations conducted between August 1985 and December 1986, as well as general conclusions as of December 1986. 9 refs., 2 figs., 4 tabs.

33445 (EPRI-GS-6404) **Staged combustion for reduced NO_x emissions from an atmospheric fluidized-bed combustor.** Duqum, J.N.; Fortino, R.T.; Loudin, K.L. Electric Power Research Inst., Palo Alto, CA (USA); Babcock and Wilcox Co., Alliance, OH (USA). Research and Development Div. c Jun 1989. 308p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

To reduce exhaust NO_x below existing levels in an atmospheric fluidized-bed combustor, two-stage combustion was studied on the 6' x 6' (6 x 6) atmospheric fluidized-bed combustion (AFBC) facility at the Babcock and Wilcox (B and W) Alliance, Ohio, Research Center. This report documents the tests and related numerical modeling. The two-stage testing was conducted with Pittsburgh No. 8 coal. NO_x was reduced to a minimum level of 132 ppM at the stack, or about 50% below baseline NO_x with overfire air (OFA). Combustion efficiency was maintained at 98% at these minimum NO_x conditions. Although acceptable sulfur capture was not maintained, tests with overbed fly ash recycle and higher OFA jet velocity indicated that sulfur capture can be brought to acceptable levels by improving freeboard mixing. Numerical modeling was investigated as a means of scaling the results of staged combustion from the 6 x 6 AFBC facility to larger AFBC units. B and W's existing three-dimensional models for pulverized-coal combustion and NO_x formation and reduction were applied to the 6 x 6 freeboard. Lagrangian particle transport models were found capable of predicting elutriation. Exit flue gas temperatures were well predicted, but internal freeboard temperatures were underpredicted. B and W's NO_x model under predicted reaction rates for fuel NO_x production and reduction. The OFA ports for this project were designed using mixing analysis without combustion. This type of analysis can help in the design of OFA ports for larger units such as Tennessee Valley Authority's 20-MW pilot-scale plant. However, additional computer code validation is required before combustion and NO_x analyses can be used for scale-up. 37 refs., 43 figs.

33446 (KTM/E-D-167) **Costs of reducing nitrogen oxide emissions from power plants.** Riionheimo, Y.; Kosonen, M.; Hellen, G.; Jaervinen, M.; Yrjoelae, V. Kauppa-ja Teollisuusministerio, Helsinki (Finland). Energiaosasto. 1989. 165p. (In Finnish). Order Number DE89776182/JAW. Available from NTIS (US Sales Only), PC A08/MF A01;1.

The purpose of this study was to identify the reduction techniques of nitrogen oxide emissions and their costs in power plants. The target group studied consisted of both over 200 MW retrofit plants and over 50 MW new plants. Primary means applicable for retrofit plants were discussed, whereas for new plants both primary and secondary means were studied. The reduction techniques utilized in Central Europe, the NO_x levels and the costs were described for background information. The costs of reduction techniques, which have reached the level of commercialization, were studied for the the conditions in Finland. A 15 year repayment period was used for retrofit plants and a 25 year repayment period for new plants. The intrest rate was 5%. Turnover tax is included in the costs.

33447 (SVF-322) **Long-term follow-up of NO_x-emissions from the Vaesthamn plant in Helsingborg.** Hjalmarsson, A.K. Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden). Nov 1988. 125p. (In Swedish). Order Number DE89776246/JAW. Available from NTIS (US Sales Only), PC A06/MF A01;1.

Long time measurement of nitrogen oxides have been made using a pulverized coal-fired steam boiler, 180 MW thermal, at Vaesthamnsverket in Helsingborg. The purpose of this project has been to establish the nitrogen oxide emissions from the boiler and find connection to other operating parameters. Data have been collected from the process instruments during normal operations and a couple of special tests have been run. The measuring period is from end of February to the end of May, 1988. This work has shown that the NO_x-content varies a lot on rather constant operating conditions. This means that short, periodical measurements often are not representative.

2003 Power Transmission and Distribution

Refer also to citation(s) 33407

33448 (BCHPA-231T446) **Analysis of gaseous SF_6 decomposition products.** Dominelli, N. British Columbia Hydro and Power Authority, Surrey, BC (Canada). 1987. 88p. (CE-02609). Available from Canadian Electrical Association, Research & Development, Suite #500, One Westmount Square, Montreal, PQ, Canada H3Z 2P9; $75.00 NON-MEMBERS; MEMBERS: PRICES UPON REQUEST, FUNDS CAN.

A novel analytical technique for the detection of trace levels of gaseous SF_6 decomposition products is discussed. A gas chromatograph equipped with an electrolytic conductivity detector was used for the detection of parts per billion of SOF_2, SO_2, COS,SF_4 and parts per million of SO_2F_2 in SF_6. Column tubing material and sample containers were evaluated for their chemical inertness towards these compounds. A field sampling system based on vacuum technique was built for reliable sample withdrawal from gas insulated substation equipment. The merits of electrolytic conductivity detectors for field applications are examined and discussed. Preliminary work with electrochemical detectors for real-time continuous monitoring of SF_6 decomposition products is presented. 32 refs., 35 figs., 6 tabs.

33449 (BCHPA-244T533) **Localized intrinsic strengthening approach. A practical method for determining the tensile strength of multistrand conductors.** Akhtar, A. British Columbia Hydro and Power Authority, Surrey, BC (Canada). 1986. 47p. (CE-02610). Available from Canadian Electrical Association, Research & Development, Suite #500, One Westmount Square, Montreal, PQ, Canada H3Z 2P9; $75.00 NON-MEMBERS; MEMBERS: PRICES UPON REQUEST, FUNDS CAN.

The objective of this paper is to explore the applicability of the Localized Intrinsic Strengthening Approach (LISA) for measuring the True Tensile Strength (TTS) of a range of multistrand conductors and guy wires of interest to electrical utilities. Localized cooling of any of a number of commercially available end fittings with liquid nitrogen has enabled a determination of the TTS for the entire range of multistrand bodies of interest. Measured values of the TTS have been found to be as much as 22.9 percent higher than the calculated Rated Tensile Strength. A standard test method is proposed, which is simple and cost effective. The technique will enable a quantitative evaluation of the efficiency of end fittings and splices as well as the determination of the residual strength of used conductors. The relationship between the strengths of a multistrand conductor and its constituent strands may now be explored so as to optimize conductor design. 9 refs., 16 figs., 7 tabs.

33450 (CONF-890555-17) **Operational aspects of distribution automation.** Rizy, D.T.; Stovall, J.P.; Lawler, J.S. Oak Ridge National Lab., TN (USA). May 1989. 18p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. From 7. power plant dynamics, control and testing symposium; Knoxville, Tennessee, USA; 15-17 May 1989. Order Number

DE89013538/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The Athens Automation and Control Experiment (AACE), a large-scale distribution automation research project, was conducted at Athens, Tennessee. The experiment involved the monitoring and control of three substations and twelve feeders (nearly the entire system) of the Athens Utilities Board (AUB). The monitoring and control hardware consists of supervisory and data acquisition, feeder monitoring and control, and customer load control. In total 75 locations on the AUB distribution system were automated and 2000 customer loads were placed under control. The controlled equipment includes 2 load-tap-changing transformers, 12 circuit breakers, 4 line regulators, 29 capacitor banks, 35 load break switches, 12 power reclosers, and 21 fault detectors. Two software programs, an automated capacitor control program and distribution automation analysis program, that have been essential to the AACE are discussed. There have been several operational benefits associated with the automation of the AUB system which are described in this paper. 10 refs., 10 figs., 1 tab.

33451 (CONF-890781–1) **Predicting air conditioner load curves from energy audit data: A comparison of predicted and actual air conditioning data from the Athens load control experiment.** Reed, J.H.; Broadwater, R.P.; Chandrasekaran, A.; Oka, A. Oak Ridge National Lab., TN (USA). 1989. 7p. Sponsored by DOE Energy Research. DOE Contract AC05-84OR21400. From IEEE summer power meeting; Long Beach, California, USA; 9-14 Jul 1989. Order Number DE89012348/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

In order to evaluate effectively the benefits of direct load control, utilities need an economical planning tool for estimating the potential effects of load control actions. Previous attempts to model the impacts of load control have met with mixed success because the models often could not be adjusted for local variations in appliance and housing stocks. This paper presents an approach for estimating air conditioning load curves based on household duty cycles. The duty cycles are calculated from heat transfer rates using household audit data, thermostat settings, and outdoor temperatures. The fit between the load curves estimated from the duty cycle model and load curves calculated from measured data for households where curves calculated from measured data for households where customers "set" and "forget" their air conditioner is presented. The air conditioner and heat pump data used in this paper were gathered during the load control experiments conducted in the summer of 1987 on the Athens Utilities Board distribution system in Athens, Tennessee. Data collected on days when there was no control were used to evaluate the concept of the duty cycle coefficient which was then used to calculate the duty cycle of heat pumps and air conditioners. The theoretical calculations based on the model are then compared to actual measured data. With further refinement to incorporate thermostat setting behavior, the method described here would allow utilities to gather relatively small amounts of survey data and then to make reliable predictions about the duty cycles of air conditioners. Ultimately the method may provide a way to perform a preliminary evaluation of load control without requiring expensive monitoring equipment, data collection, analysis and interpretation. 11 refs., 6 figs., 4 tabs.

33452 (CONF-890781–2) **The effects of steep-front, short-duration impulses on power distribution components.** Miller, D.B.; Lux, A.E.; Grzybowski, Stanislaw; Barnes, P.R. Oak Ridge National Lab., TN (USA). Jul 1989. 7p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. From IEEE summer power meeting; Long Beach, California, USA; 9-14 Jul 1989. Order Number DE89012338/JAW. Available from NTIS, PC A02/MF A01 - OSTI.

A line type pulser has been developed to test the effects of steep-front, short duration (SFSD) pulses on distribution components. Risetime is 50-100 ns, and pulse duration is on the order of 300 ns. Terminators often shattered or punctured rather than flashing over. Insulator flashover voltage is approximately 1.5 times CFO for standard lightning impulses. Arresters exhibit an inductive character, with SFSD peak voltage at 10 kA approximately 4–5 times the 8 x 20 microsecond 10 kA discharge voltage. Polyethylene insulated cable has a characteristic degradation in which failure voltage decreases with number of SFSD pulses. 7 refs., 12 figs., 2 tabs.

33453 (IREQ–145T327) **Methods of evaluating dynamic characteristics of dampers, spacers and spacer-dampers.** Bourdon, P.; Brunelle, J.; Lavigne, P. Institut de Recherche d'Hydro-Quebec, Varennes, PQ (Canada). 1987. 222p. (CE–02601). Available from Canadian Electrical Association, Research & Development, Suite #500, One Westmount Square, Montreal, PQ, Canada H3Z 2P9; $75.00 NON MEMBERS; MEMBERS: PRICES UPON REQUEST, FUNDS CAN.

The objective of this project was to develop practical methods of evaluating and presenting the dynamic characteristics of dampers, spacers and spacer dampers in quantitative terms. Dampers, spacers and spacer-damers are used for the protection of overhead line conductors against the harmful effects of wind-induced vibrations. This report describes the method which was developed to determine the dynamic characteristics of these devices and presents some representative results of its application. Spectral and modal analyzers were used to obtain a modal representation of the dynamic characteristics of dampers, spacers and spacer-dampers in the free-free condition. The technique of experimental modal analysis, when applied under the conditions identified in this project, provides a modal model of the tested object which fits well with measured dynamic data in all cases where the dynamic characteristics can be considered at least piecewise linear. The method provides a compact and accurate method of evaluating the dynamic characteristics of dampers, spacers and spacer dampers. The generalized use of this method of identification would allow most dampers, spacers and spacer- dampers to be characterized in a uniform way, a fact useful to the transmission line design engineer. 16 refs., 19 figs.

21 NUCLEAR POWER PLANTS

Refer also to citation(s) 33429, 33570

33454 (DOE/EIA–0473(88)) **Nuclear power plant construction activity, 1988.** USDOE Energy Information Administration, Washington, DC (USA). Office of Coal, Nuclear, Electric and Alternate Fuels. 14 Jun 1989. 53p. Sponsored by DOE Management & Administration. Order Number DE89014646/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

Nuclear Power Plant Construction Activity 1988 presents cost estimates, chronological data on construction progress, and the physical characteristics of nuclear units in commercial operation and units in the construction pipeline as of December 31, 1988. This report, which is updated annually, was prepared to provide an overview of the nuclear power plant construction industry. The report contains information on the status of nuclear generating units, average construction costs and lead-times, and construction milestones for individual reactors.

33455 (IAEA-TECDOC–497) **OSART results II. A summary of the results of Operational Safety Review Team Missions during the period June 1987 to May 1988.** International Atomic Energy Agency, Vienna (Austria). Feb 1989. 155p. Order Number DE89618203/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

The IAEA Operational Safety Review Team (OSART) programme provides advice and assistance to Member States for enhancing the operational safety of nuclear power plants. OSART reviews are available to all countries with nuclear power plants in operation or approaching operation. Most of these countries have participated in the programme, by hosting one or more OSART missions or by making experts available to participate in missions. The observations of the OSART members are documented in technical notes which are then used as source material for the official OSART Report submitted to the government of the host country. The technical notes contain recommendations for improvements and description of commendable good practices. The same notes have been used to compile the present summary report which is intended for wide distribution to all organizations constructing, operating or regulating nuclear power plants. This report is the second in a series that was started by IAEA-TECDOC-458. The next report is planned to be a

summary of OSART missions during the twelve months from June 1988 to May 1989.

33456 (IAEA-TECDOC–498) **Good practices for improved nuclear power plant performance.** International Atomic Energy Agency, Vienna (Austria). Apr 1989. 177p. Order Number DE89620239/JAW. Available from NTIS (US Sales Only), PC A09/MF A01 - OSTI; INIS.

This report provides an overview of operational principles, practice and improvements which have contributed to good performance of eight selected world nuclear power stations. The IAEA Power Reactor Information System (PRIS) was used to identify a population of good performers. It is recognized that there are many other good performing nuclear power stations not included in this report. Specific criteria described in the introduction were used in selecting these eight stations. The information contained in this report was obtained by the staff from IAEA, Division of Nuclear Power. This was accomplished by visits to the stations and visits to a number of utility support groups and three independent organizations which provide support to more than one utility. The information in this report is intended as an aid for operating organizations to identify possible improvement initiatives to enhance plant performance. Figs and tabs.

33457 (INIS-mf–11455) **Nuclear power reactors.** Hermansky, B. Ceskoslovenska Komise pro Atomovou Energii, Prague (Czechoslovakia). 1988. 260p. (In Czech). Order Number DE89618204/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

A survey is given of the present state and prospects of nuclear power reactors in the world, namely WWERs, PWRs, BWRs, heavy water cooled and moderated reactors, high temperature and fast reactors, and water cooled graphite moderated reactors of Soviet design. For each reactor the basic project design concept is characterized, the development trends are described as are concrete projects which represent the trends. Attention is then focussed on the use of power reactors in nuclear power and heat plants and in heating plants. Briefly outlined is the role of nuclear power in the world consumption of primary energy with an outlook to the year 2030. (Z.M.). 148 figs., 29 tabs., 109 refs.

33458 (INIS-mf–11982) **Safety and reliability of pressure components with special emphasis on the contribution of component and large specimen testing to structural integrity assessment methodology. Vol. 1 and 2. Vol. 1: Fracture mechanics, dynamic loading, nondestructive testing, radiation embrittlement. Vol. 2: Pipe failure, components, thermal shock loading, high temperature behaviour, integrity of vessels, integrity of welded joints.** Staatliche Materialpruefungsanstalt, Stuttgart (Germany, F.R.). 1987. 1129p. (In German). (CONF-8710410–: 13. MPA seminar on safety and reliability of pressure components: the contribution of component and large specimen testing to structural integrity assessment methodology, Stuttgart, Germany, F.R., 8-9 Oct 1987). Order Number DE89783126/JAW. Available from NTIS (US Sales Only), PC A99/MF A01.

Published in 2 separate volumes.

The 51 papers of the 13. MPA-seminar contribute to structural integrity assessment methodology with special emphasis on the component and large specimen testing. 8 of the papers deal with fracture mechanics, 6 papers with dynamic loading, 13 papers with nondestructive testing, 2 papers with radiation embrittlement, 5 papers with pipe failure, 4 papers with components, 2 papers with thermal shock loading, 5 papers with the high temperature behaviour, 4 papers with the integrity of vessels and 3 papers with the integrity of welded joints. Especially also the fracture behaviour of steel material is verificated. All papers are separately indexed and analysed for the database.

33459 (SAND–88-2145C) **Characterization of in-containment cables for nuclear plant life extension.** DuCharme, A.R.; Bustard, L.D. Sandia National Labs., Albuquerque, NM (USA). 1988. 9p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890721–4: Joint ASME/JSME pressure vessel and piping conference, Honolulu, Hawaii, USA, 23-27 Jul 1989). Order Number DE89003168/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Electrical cable is made by a large number of manufacturers and used for a variety of applications in nuclear plants. cables have been identified in the Monticello and Surry Pilot Plant life extension studies and the NRC Nuclear Plant Aging Research Program as components important to the economic and safety aspects of life extension. Currently, fitness for service is largely determined by pre-operational testing. The US Department of Energy is supporting work at Sandia National Laboratories to assess the technical basis for the life extension of cables found inside containment at US nuclear plants. The work is being performed in coordination with the Nuclear Management and Resource Council's (NUMARC) NUPLEX Working Group. The initial task of this effort is to characterize the design attributes of in-containment cables. This has been completed via development of a data base depicting the manufacturer, type, material composition, use, qualification, and relative popularity of cables installed in containment. Other ongoing work is focused on a review of cable operational experience and assessment of the issues affecting cable life extension. In the long term, the work aims to identify the technical criteria and life extension strategies needed to support continued cable qualification by nuclear plant owner/operators. 7 refs., 4 tabs.

2101 Power Reactors, Non-breeding, Light-water Moderated, Boiling Water Cooled

Refer also to citation(s) 33487, 33494, 33496, 33499, 33502, 33503, 33504, 33505, 33506, 33523, 33532, 33574, 33575, 33576, 33577, 33578, 33579, 33580, 33581, 33590, 33591, 33592, 33872, 34195

33460 (EPRI-NP–6387) **Estimates of Zircaloy integrity during dry storage of spent nuclear fuel: Final report.** Miller, A.K.; Brooks, M.; Cheung, T.Y.; Tasooji, A.; Wood, J.C.; Kelm, J.R.; Surette, B.A.; Frost, C.R. Electric Power Research Inst., Palo Alto, CA (USA); Stanford Univ., CA (USA). Dept. of Materials Science and Engineering; Atomic Energy of Canada Ltd., Chalk River, ON (Canada). Chalk River Nuclear Labs.; Ontario Hydro, Toronto, ON (Canada). c May 1989. 168p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The analytical and experimental work described in this report is intended to predict the integrity of light-water reactor (LWR) fuel rods when the fuel rods are stored dry. The analytical portion considered all failure mechanisms that could be expected to operate under dry storage conditions, including creep rupture, external oxidation stress-corrosion cracking (SCC), fatigue, and clad splitting by UO_2 oxidation. Existing physically based models were used to predict the probability that LWR fuel rod cladding will fail in 100 years, as a function of the temperature at which the rods are stored. In the experimental portion, SCC tests were conducted on irradiated Zircaloy cladding to determine characteristics under conditions relevant to dry storage. "Precracked" and "smooth" (with only small naturally occurring flaws) specimens of irradiated cladding were subjected to "split ring" tests at initial stresses on the order of the yield stress in a variety of atmospheres containing iodine or cesium/cadmium. Most precracked specimens failed by SCC, and about one-third of smooth specimens irradiated to fluence above 2.5×10^{24} n/m^2 also failed. However, the stresses present in these tests were much higher than those expected in stored fuel cladding; therefore, the experimental results do not necessarily indicate likely SCC problems in dry-storage fuel. 68 refs., 54 figs., 35 tabs.

33461 (IAEA-TECDOC–489) **Safety aspects of water chemistry in light water reactors.** International Atomic Energy Agency, Vienna (Austria). Dec 1988. 79p. Order Number DE89618207/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

The goals of the water chemistry control programmes are to maximize operational safety and the availability and operating life of primary system components, to maximize fuel integrity, and to control radiation buildup. To achieve these goals an effective corporate policy should be developed and implemented. Essential management responsibilities are: Recognizing of the long-term benefits of avoiding or minimizing: (a) system corrosion; (b) fuel failure; and (c) radiation buildup. The following control or diagnostic parameters are suitable performance indicators: for PWR primary coolant circuits: pH of reactor water (by operating temperature); Concentration of

chlorides in reactor water; Hydrogen (or oxygen) in reactor water. For PWR secondary coolant circuits: pH in feedwater; Cation productivity in steam generator blowdown; Iron concentration in feedwater; Oxygen concentration in condensate. And BWR coolant circuits: Conductivity of reactor water; Concentration of chlorides in reactor water; Iron concentration in feedwater; Copper concentration in feedwater. The present document represents a review of the developments in some Member States on how to implement a reasonable water chemistry programme and how to assess its effectiveness through numerical indicators. 12 figs, 20 tabs.

33462 (INIS-mf–11982, pp. 1.1-1.19) **State of the art in manufacture of heavy forged parts for reactor components in the FRG.** Erve, M. (Siemens A.G. Unternehmensbereich KWU, Erlangen (Germany, F.R.)); Papouschek, F.; Fischer, K.; Maidorn, C. Staatliche Materialpruefungsanstalt, Stuttgart (Germany, F.R.); Kraftwerk Union A.G., Erlangen (Germany, F.R.); Thyssen Henrichshuette A.G., Hattingen (Germany, F.R.). 1987. (In German). (CONF-8710410–: 13. MPA seminar on safety and reliability of pressure components: the contribution of component and large specimen testing to structural integrity assessment methodology, Stuttgart, Germany, F.R., 8-9 Oct 1987). In *Safety and reliability of pressure components with special emphasis on the contribution of component and large specimen testing to structural integrity assessment methodology. Vol. 1. Fracture mechanics, dynamic loading, nondestructive testing, radiation embrittlement.* Order Number DE89783126/JAW. Available from NTIS (US Sales Only), PC A99/MF A01.

The development, which began with the reactor pressure vessel to be carried forth to all primary circuit components including those relevant to the operational safety of the external systems, was only possible through continual contact between the constructor, materials technologist, forged component manufacturer and those involved with the subsequent processing. In the case of the boiling water reactor (KWU), this lead to a component design which was adapted to the farging technology in which the practicable limits were stipulated by the capacities in the steel mill and the forge, by the heat-treating facilities, or the possibilities of further mechanical processing. In this report, a number of examples of such are presented which simultaneously represent the present 'state of the art' for the manufacture of heavy target reactor components in Germany.

33463 (STUDSVIK-STSR–4) **Power ramping of the PWR rods PK4/1, 2, 3 and PK6/1, 2, 3 Irradiation report: The Studsvik Super-Ramp Project.** Roennberg, G. Studsvik Energiteknik AB, Nykoeping (Sweden). Jan 1981. 42p. Sponsored by DOE Nuclear Energy. DOE Contract FG06-80ET34032. Order Number DE89013229/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; GPO Dep.

Three rods from the PK4 group and three from the PK6 group were ramp tested in R2 during August and September 1980. The power ramps were performed according to the decisions at the first project committee meeting, with a modification for rod PK4/3 made by the project manager. 3 refs., 30 figs., 1 tab.

33464 (STUDSVIK-STSR–14) **Non-destructive examination of PW3 rods: The Super-Ramp Project.** Lysell, G. Studsvik Energiteknik AB, Nykoeping (Sweden). Oct 1981. 22p. Sponsored by DOE Nuclear Energy. DOE Contract FG06-80ET34032. Order Number DE89013239/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; GPO Dep.

This report covers all NDE performed before and after ramp testing of the four PW3 rods. Examinations include visual inspection, EC testing, dimensional measurement, gamma scanning, and neutron radiography.

33465 (STUDSVIK-STSR–15) **Power ramping of the rods PW5/1, 2 and 3: Irradiation report: The Super-Ramp Project.** Roennberg, G. Studsvik Energiteknik AB, Nykoeping (Sweden). [1981]. 25p. Sponsored by DOE Nuclear Energy. DOE Contract FG06-80ET34032. Order Number DE89013240/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; GPO Dep.

The three first PW5 rods were ramp tested in R2 in May 1981. The power ramps were performed with the test conditions agreed upon at the first project committee meeting and the test matrix agreed upon at the second project committee meeting. The ramp test results are summarized in this report. 4 refs., 19 figs., 1 tab.

33466 (STUDSVIK-STSR–22) **Destructive examination of PW3 and PW5 rods: The Super-Ramp Project.** Birath, S.; Lysell, G. Studsvik Energiteknik AB, Nykoeping (Sweden). Sep 1982. 45p. Sponsored by DOE Nuclear Energy. DOE Contract FG06-80ET34032. Order Number DE89013247/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; GPO Dep.

This report covers the destructive examinations after ramp testing on the rods PW 3/2, PW 3/3, PW 3/4, PW 5/2, and PW 5/3. The following destructive examinations which have been performed after ramp testing are reported here: fission gas analysis, metallography, clad inspection, SEM, burnup analysis. The non-destructive examinations after ramp on the PW 3 rods were reported in STSR-14 and the non destructive examinations after ramp on the PW 5-rods will be reported in STSR-23. Three more metallography samples will be made on PW 3/4 and PW 5/3 but will be reported separately.

33467 (STUDSVIK-STSR–25) **Complementary metallography on the rods PW 3/4 and PW 5/3: The Super-Ramp Project.** Birath, S.; Lysell, g.; Mattsson, O. Studsvik Energiteknik AB, Nykoeping (Sweden). Dec 1982. 31p. Sponsored by DOE Nuclear Energy. DOE Contract FG06-80ET34032. Order Number DE89013250/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; GPO Dep.

The main part of the destructive examinations on the PW 3 and the PW 5 rods were reported in STSR-22. After the edition of that report complementary metallography has been performed. The extent of this metallography, which is reported in the present report is one transversal and one longitudinal section on rod PW 5/3.

33468 (STUDSVIK-STSR–26) **Non-destructive examinations of BG8 and BG9 rods: The Super-Ramp Project.** Bergenlid, U.; Birath, S.; Bivered, B.; Brisling, A.; Lysell, G. Studsvik Energiteknik AB, Nykoeping (Sweden). Mar 1983. 23p. Sponsored by DOE Nuclear Energy. DOE Contract FG06-80ET34032. Order Number DE89013251/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; GPO Dep.

This report covers all NDE performed before and after ramp testing of the four BG8 and the four BG9 rods. The following nondestructive examinations have been performed on these rods: Visual Inspection, EC Testing, Profile Measurement, Gamma Scanning, and Neutron Radiography.

33469 (STUDSVIK-STSR–27) **The Studsvik Super-Ramp Project: Quarterly progress report, October–December, 1982.** Djurle, S. Studsvik Energiteknik AB, Nykoeping (Sweden). Jan 1983. 26p. Sponsored by DOE Nuclear Energy. DOE Contract FG06-80ET34032. Order Number DE89013252/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; GPO Dep.

This is the tenth quarterly progress report distributed from the STUDSVIK SUPER-RAMP Project. It covers the fourth quarter of 1982. The scope of the Technical Program for the SUPER-RAMP Project is an experimental investigation of the pellet-clad interaction (PCI) performance under power ramp conditions for commercial type LWR test fuel rods irradiated to high burnup. The program incorporates rods of PWR standard as well as modified designs and rods of BWR standard design. 6 refs., 3 figs., 2 tbs.

33470 (STUDSVIK-STSR–28) **Power ramping of Super-Ramp test fuel rods: Final irradiation report: The Super-Ramp Project.** Roennberg, G. Studsvik Energiteknik AB, Nykoeping (Sweden). 20 Oct 1983. 126p. Sponsored by DOE Nuclear Energy. DOE Contract FG06-80ET34032. Order Number DE89013253/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; GPO Dep.

The power ramp testing of the 44 fuel rods started in August 1980 and was finished in November 1982. The rods form nine groups of 4 to 8 rods in each group. Detailed rod data are found in the fabrication and base irradiation reports. The irradiation histories during the ramp testing are presented in the nine Appendices A to I, one for each group of rods. 2 refs., 4 figs., 3 tabs.

33471 (STUDSVIK-STSR–29) **Post-ramp examinations of KWU/CE rods at Karlstein: The Super-Ramp Project.** Dewes, P.; Lorz, E. Studsvik Energiteknik AB, Nykoeping (Sweden); Kraftwerk

Union A.G., Erlangen (Germany, F.R.). Hauptbereich Brennstoffkreislauf. Aug 1983. 92p. Sponsored by DOE Nuclear Energy. DOE Contract FG06-80ET34032. Order Number DE89013254/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; GPO Dep.

In the Studsvik Super-Ramp Project 19 PWR and 8 BWR test fuel rods supplied by KWE/CE were power ramp tested. The destructive post-ramp examinations were carried out in the KWU hot cells at Karlstein. The examination program mainly consisted of fission gas analyses of non-failed rods, burnup analyses of one rod each taken from three fuel rod groups, metallography and study of clad internal surface by means of SEM. This report presents the measured data and describes the metallographic and SEM results from the fuel and cladding examinations. 2 refs., 44 figs., 5 tabs.

33472 (STUDSVIK-STSR–30) **The Studsvik Super-Ramp Project: Quarterly progress report, January–March 1983 and April–June 1983 [first and second quarters].** Djurle, S. Studsvik Energiteknik AB, Nykoeping (Sweden). Aug 1983. 29p. Sponsored by DOE Nuclear Energy. DOE Contract FG06-80ET34032. Order Number DE89013255/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; GPO Dep.

This is the eleventh Quarterly Progress Report distributed from the Studsvik Super-Ramp Project. It covers the first and second quarters of 1983. The scope of the Technical Program for the Super-Ramp Project is an experimental investigation of the pellet-clad interaction (PCI) performance under power ramp conditions for commercial type LWR test fuel rods irradiated to high burnup. The program incorporates rods of PWR standard as well as modified designs and rods of BWR standard design. 12 refs., 3 figs., 2 tabs.

33473 (STUDSVIK-STSR–31) **Destructive examinations of BG8 and BG9 rods: The Studsvik Super-Ramp Project.** Birath, S.; Bivered, B.; Mattsson, O.; Lysell, G. Studsvik Energiteknik AB, Nykoeping (Sweden). Feb 1984. 80p. Sponsored by DOE Nuclear Energy. DOE Contract FG06-80ET34032. Order Number DE89013256/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; GPO Dep.

This report covers all destructive examinations performed before and after ramp testing of the four BG8 and the four BG9 rods. The following destructive examinations have been performed on these rods: fission gas analysis, burnup analysis, and metallography. 1 ref.

33474 (STUDSVIK-STSR–32) **The Studsvik Super-Ramp Project: Final report.** Djurle, S. Studsvik Energiteknik AB, Nykoeping (Sweden). Dec 1984. 231p. Sponsored by DOE Nuclear Energy. DOE Contract FG06-80ET34032. Order Number DE89013016/JAW. Available from NTIS (US Sales Only), PC A11/MF A01 - OSTI; GPO Dep.

The STUDSVIK SUPER-RAMP Project, an internationally sponsored research project, investigated the failure propensity of typical light water reactor test fuel rods when subjected to power ramps, after base irradiation to high burnup. The Project power ramped 28 individual PWR test fuel rods in a PWR subprogram and 16 test fuel rods in a BWR subprogram. All the rods underwent a thorough examination program, comprising characterization prior to the base irradiation, examinations interim to base and ramp irradiations and examinations after the ramp irradiation. 83 refs., 76 figs., 27 tabs.

33475 (STUDSVIK-STSRX–5) **Results of profilometry, E C tests and radiography of test rods supplied by Asea-Atom: The Studsvik Super-Ramp Extension Project.** Bergenlid, U.; Brisling, A.; Carlsson, J.; Gustafsson, I. Studsvik Energiteknik AB, Nykoeping (Sweden). Sep 1984. 18p. Sponsored by DOE Nuclear Energy. DOE Contract FG01-84NE34122. Order Number DE89012712/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; GPO Dep.

Six BWR test fuel rod segments supplied by Asea-Atom were ramp tested in order to determine a safe conditioning ramp rate. The terminal power levels were 44 kW/m in all cases except segment OL1-1, which was ramped to 48 kW/m, Examinations by means of profilometry, eddy current tests and neutron radiography were performed. 13 figs.

33476 (STUDSVIK-STSRX–6) **Hot cell examinations of AA test fuel rods: The Studsvik Super-Ramp Extension Project.** Birath, S. Studsvik Energiteknik AB, Nykoeping (Sweden). Sep 1984. 17p. Sponsored by DOE Nuclear Energy. DOE Contract FG01-84NE34122. Order Number DE89012713/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; GPO Dep.

This report covers the following examinations performed in hot cells: pellet/clad gap measurements on five segments, fission gas analysis of four segments, and visual inspection of the two failed segments. 5 figs., 3 tabs.

33477 (SVF–291) **Erosion corrosion in wet steam.** Tavast, J. Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden). Mar 1988. 61p. (In Swedish). Order Number DE89618208/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

The effect of different remedies against erosion corrosion in wet steam has been studied in Barsebaeck 1. Accessible steam systems were inspected in 1984, 1985 and 1986. The effect of hydrogen peroxide injection of the transport of corrosion products in the condensate and feed water systems has also been followed through chemical analyses. The most important results of the project are: - Low alloy chromium steels with a chromium content of 1-2% have shown excellent resistance to erosion corrosion in wet steam. - A thermally sprayed coating has shown good resistance to erosion corrosion in wet steam. In a few areas with restricted accessibility minor attacks have been found. A thermally sprayed aluminium oxide coating has given poor results. - Large areas in the moisture separator/reheater and in steam extraction no. 3 have been passivated by injection of 20 ppb hydrogen peroxide to the high pressure steam. In other inspected systems no significant effect was found. Measurements of the wall thickness in steam extraction no. 3 showed a reduced rate of attack. - The injection of 20 ppb hydrogen peroxide has not resulted in any significant reduction of the iron level result is contrary to that of earlier tests. An increase to 40 ppb resulted in a slight decrease of the iron level. - None of the feared disadvantages with hydrogen peroxide injection has been observed. The chromium and cobalt levels did not increase during the injection. Neither did the lifetime of the precoat condensate filters decrease.

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Refer also to citation(s) 33460, 33461, 33462, 33463, 33464, 33465, 33466, 33467, 33468, 33469, 33470, 33471, 33472, 33473, 33474, 33476, 33523, 33534, 33567, 33568, 33574, 33575, 33576, 33579, 33580, 33581, 33589, 33590, 33591, 33592, 33872, 34180, 34189

33478 (CEA-CONF–9699) **Analysis of impact phenomena between PWR fuel assemblies in earthquake situations.** Queval, J.C.; Brochard, D. CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Etudes Mecaniques et Thermiques. 1988. 24p. (CONF-8806217–: ASME pressure vessel and piping conference: vibration and seismic response of fluid-structure systems, Pittsburgh, Pennsylvania, USA, 19-23 Jun 1988). Order Number DE89760601/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

To qualify fuel assembly seismic resistance and to promote the development of new grid designs, FRAMATOME (Fuel Division) in cooperation with CEA have launched a large scale experimental program which will lead to the design of improved models for safety analyses. The tests performed on full scale mock-ups were devoted to analyse: - the vibratory behaviour (frequency, damping) of the fuel assembly as a function of two important parameters: the motion amplitude and the holddown force. The effect of the fluid on these characteristics has been also investigated. - The behaviour of the assemblies during impacts (impact against a rigid wall and impact between two assemblies). The aim of this paper is to present the main results of these tests and the modelisation of the fuel assembly, developed to interpret these tests. Some correlations between experimental and calculation results will be shown.

33479 (CEGB-TPRD/L–3275/R88) **Determination of magnesium in simulated PWR coolant by graphite furnace atomic**

absorption spectrometry. Gatford, C.; Torrance, K. Central Electricity Research Labs., Leatherhead (UK). Jun 1988. 25p. Order Number DE89618209/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The determination of magnesium in simulated PWR coolant has been investigated by graphite furnace atomic absorption spectrometry with atomization from a L'vov platform. The presence of boric acid in the coolant suppresses the magnesium absorption to such an extent that removal of the boron is necessary and three variations of a methyl borate volatilization technique for the in situ removal of boron from the sample platform were investigated. This work has shown that dilution of the sample with an equal volume of acidified methanol and volatilization of the methyl borate was adequate for the determination of magnesium in coolant samples containing up to 2000 mg 1^{-1} of boron. In simulated coolant samples containing 25 and 4 μg 1^{-1} of magnesium, positive biases of about 2 and 0.5 μg 1^{-1} were measured and these errors were considered to be due to contamination. The limit of detection in the presence of 100 and 2000 mg 1^{-1} boron were 0.14 and 0.93 μg 1^{-1} respectively. These performance characteristics suggest the method is completely acceptable for monitoring the chemical purity of PWR coolant and associated waters containing boric acid. If, however, more precise analyses were to be required for research purposes then any significant improvement in the above figures would require increased purity of reagents, clean-room conditions to reduce contamination and a more versatile atomic absorption spectrophotometer.

33480 (EPRI-NP–6356-M) **Qualification of PWR steam generator chemical cleaning for Indian Point-2: Final report.** Prestegiacomo, J.B.; Baum, A.J.; Sagar, A.; Schneidmiller, D. Electric Power Research Inst., Palo Alto, CA (USA); Westinghouse Electric Corp., Pittsburgh, PA (USA). Service Technology Div.; Pacific Nuclear Services, Richland, WA (USA). c May 1989. 129p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

A qualification program for the chemical cleaning of the secondary side of steam generators (SGs) was conducted in anticipation of potential application of the Electric Power Research Institute/Steam Generator Owners Group (EPRI/SGOG) generic cleaning process at Indian Point 2 (IP-2). The field application would be a partial cleaning below the first tube support to remove tubesheet sludge from four Westinghouse Model 44 SGs, similar to the cleanings performed on Combustion Engineering Model SGs at Millstone 2 in 1985 and Maine Yankee in 1987. Program tasks were designed with the following goals: (1) identify and incorporate the "lessons learned" from the Millstone 2 tubesheet cleaning experience; (2) review and analyze IP-2 features, e.g., SG sludge, deposits, materials and weld geometries, in order to properly mock up plant-specific features in the qualification testing; (3) determine the effectiveness and effects of the process, using plant sludge, SG mock-ups for materials compatibility evaluations and expected field procedures; and (4) identify any unresolved technical issues associated with the process. This summary report also presents an overview of the conceptual engineering of the field application, i.e., process design, equipment layout/requirements and operating procedures, and a brief overview of licensing and waste disposal issues associated with the field application. 23 refs., 33 figs., 20 tabs.

33481 (EPRI-NP–6361) **Guidelines for improving fuel reliability: Final report.** Strasser, A.A.; Sheppard, K.D.; Epstein, R. Electric Power Research Inst., Palo Alto, CA (USA); Stoller (S.M.) Corp., Pleasantville, NY (USA). c Apr 1989. 152p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The reliable performance of fuel is important to minimize personnel exposure and to operate the plants in an economic manner. As part of a utility and EPRI effort to improve reliability, current PWR operations in the US, Europe, and Japan were reviewed and evaluated for, methods of operation with failed fuel, and practices that help improve fuel reliability. Based on the findings and Stoller's data bases, guidelines were developed for operating with failed fuel and subsequent end-of-cycle activities, including examinations, and for improving fuel reliability in general. 30 figs., 21 tabs.

33482 (INIS-mf–11425) **Status of PNPP-1.** Correa, F.S. National Power Corp., Diliman, Quezon City (Philippines). Operations Div. 1989. 14p. (CONF-8902112–: 29. annual convention of the Radioisotope Society of the Philippines, Quezon City, Philippines, 28 Feb 1989). Order Number DE89618210/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The mothballing of the first Philippine Nuclear Power Plant (PNPP-1) in Bagac, Bataan started 1 May 1986 following the change of leadership in the Philippine government. The plant was 98% complete and preoperation was completed in 1985 while awaiting license to load the core. The short term plant lay-up program was implemented first with the objectives of placing the plant in "CORE LOAD READINESS" in which 17 systems were placed under the WET lay-up mode of preservation, 59 major components under the DRY lay-up mode, and 46 systems were in operation to support the short term preservation programs. As of the end of Dec 1988 there are 110 systems mothballed, 39 systems still in operation to support the preservation requirements (mostly air-conditioning/ventilating systems, rain water system and electrical/lighting system) and four (4) systems undergoing mothball entry after it was determined not needed to support preservation activities. 94 of the 110 systems are permanent plant systems, the rest auxiliary/ancilliary systems. The nuclear fuels (1 initial core and 1 reload) are still in the plant. (ELC).

33483 (INIS-mf–11453) **Operation of nuclear power plants. Instruction manual.** Severa, P. Vyskumny Ustav Jadrovych Elektrarni, Trnava (Czechoslovakia). Rezortne Skoliace a Vycvikove Stredisko. Apr 1988. 52p. (In Slovak). Order Number DE89618211/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

The textbook for training nuclear power plant personnel is centred on the most important aspects of operating modes of WWER-440 reactors. Attention is devoted to the steady state operation of the unit, shutdown, overhaul with refuelling, physical and power start-up. Also given are the regulations of shift operation and the duties of individual categories of personnel during the shift and during the change of shifts. (Z.M.). 3 figs., 1 tab.

33484 (INIS-mf–11982, pp. 28.1-28.17) **B and W Owners Group Reactor Vessel Integrity Program - the first ten years.** Lowe, A.L. Jr. (Babcock and Wilcox Co., Lynchburg, VA (USA). Nuclear Power Div.); Moore, K.E.; Gross, L.B. Staatliche Materialpruefungsanstalt, Stuttgart (Germany, F.R.); Babcock and Wilcox Co., Lynchburg, VA (USA). Nuclear Power Div. 1987. (CONF-8710410–: 13. MPA seminar on safety and reliability of pressure components: the contribution of component and large specimen testing to structural integrity assessment methodology, Stuttgart, Germany, F.R., 8-9 Oct 1987). In *Safety and reliability of pressure components with special emphasis on the contribution of component and large specimen testing to structural integrity assessment methodology. Vol. 1. Fracture mechanics, dynamic loading, nondestructive testing, radiation embrittlement.* Order Number DE89783126/JAW. Available from NTIS (US Sales Only), PC A99/MF A01.

Responding to the need for data and analytical techniques to address the regulatory requirements, the B and W Owners Group initiated a multiphase program. This program had two major objectives - one short-term and the other long-term - both aimed at demonstrating compliance with the requirements of 10CFR50, Appendix G. The short-term solution (Phase I) had the goal of maximizing the length of time that the requirements of 10CFR50, Appendix G, are satisfied for each Owners Group reactor vessel without extensive evaluation and analysis. The target plant availability for Phase I was ten calendar years from when each of the Owners Group plants was placed in commercial operation. The long-term solution (Phases II through X) had the goal of developing methodology and obtaining data to demonstrate that each plant possesses an adequate marginal safety to prevent nonductile failure for the full 40-year plant design life.

33485 (INIS-mf–11982, pp. 34.1-34.20) **Standardization of pipe supports for nuclear power plants under consideration of aptitude tests.** Lauer, J. (Siemens A.G. Unternehmensbereich KWU, Offenbach am Main (Germany, F.R.)); Labes, M.; Huelsen, H. Staatliche Materialpruefungsanstalt, Stuttgart (Germany, F.R.); Kraftwerk Union A.G., Offenbach am Main (Germany, F.R.);

Kraftwerk Union A.G., Erlangen (Germany, F.R.). 1987. (In German). (CONF-8710410–: 13. MPA seminar on safety and reliability of pressure components: the contribution of component and large specimen testing to structural integrity assessment methodology, Stuttgart, Germany, F.R., 8-9 Oct 1987). In *Safety and reliability of pressure components with special emphasis on the contribution of component and large specimen testing to structural integrity assessment methodology. Vol. 2. Pipe failure, components, thermal shock loading, high temperature behaviour, integrity of vessels, integrity of welded joints.* Order Number DE89783126/JAW. Available from NTIS (US Sales Only), PC A99/MF A01.

In accordance with the standardization and rationalization for KONVOI plants, the German KWU has devised a catalogue of supports for mass-produced pipes. This catalogue contains technical standards in the broadest sense, concerning mass-produced standard-support components, which may be assembled according to the functional and geometrical peripheral conditions to complete pipe support units. The advantages of the catalogue are presented.

33486 (INIS-mf–11982, pp. 35.1-35.20) **Material compatibility of the chemical cleaning of steam generators with chelating solutions.** Stellwag, B. (Siemens A.G. Unternehmensbereich KWU, Erlangen (Germany, F.R.)); Odar, S. Staatliche Materialpruefungsanstalt, Stuttgart (Germany, F.R.); Kraftwerk Union A.G., Erlangen (Germany, F.R.). 1987. (In German). (CONF-8710410–: 13. MPA seminar on safety and reliability of pressure components: the contribution of component and large specimen testing to structural integrity assessment methodology, Stuttgart, Germany, F.R., 8-9 Oct 1987). In *Safety and reliability of pressure components with special emphasis on the contribution of component and large specimen testing to structural integrity assessment methodology. Vol. 2. Pipe failure, components, thermal shock loading, high temperature behaviour, integrity of vessels, integrity of welded joints.* Order Number DE89783126/JAW. Available from NTIS (US Sales Only), PC A99/MF A01.

This report concerns the material compatibility with the KWU cleaning technique, involving chelating NTA-solutions to chemically purify the secondary coolant-circuits of pressurized water reactor steam generators. The experiments were focussed on surface corrosion, local selective corrosion and contact corrosion with wrought, cast and welded materials. These included pure and low-alloy steels, chromium steels, austenitic Cr-Ni-steels, nickel base alloys, and various wear-resistent material. The criteria for the choice of material and the results obtained are presented.

33487 (INIS-mf–11982, pp. 36.1-36.20) **Valve testing and development in the laboratories of Kraftwerk Union.** Simon, U. (Siemens A.G. Unternehmensbereich KWU, Erlangen (Germany, F.R.)); Dernbach, B. Staatliche Materialpruefungsanstalt, Stuttgart (Germany, F.R.); Kraftwerk Union A.G., Erlangen (Germany, F.R.). 1987. (In German). (CONF-8710410–: 13. MPA seminar on safety and reliability of pressure components: the contribution of component and large specimen testing to structural integrity assessment methodology, Stuttgart, Germany, F.R., 8-9 Oct 1987). In *Safety and reliability of pressure components with special emphasis on the contribution of component and large specimen testing to structural integrity assessment methodology. Vol. 2. Pipe failure, components, thermal shock loading, high temperature behaviour, integrity of vessels, integrity of welded joints.* Order Number DE89783126/JAW. Available from NTIS (US Sales Only), PC A99/MF A01.

Valves represent the most abundant group of active components in nuclear power stations. Altogether, approx. 700 valves are of direct relevance to the systems technical safety. Hence, the German KWU has developed a valve maintenance system, offered to power station operators as a commercial service. The experience gathered during the diagnostic tests conducted since 1985 in seven nuclear power stations is presented. This is supplemented by a preliminary statistical evaluation of the over 500 valves checked to date. Various valve testing facilities are briefly described.

33488 (INIS-mf–11982, pp. 37.1-37.25) **Shafts of main coolant pumps. Failure analysis and remedies.** Loehberg, R. (Siemens A.G., Erlangen (Germany, F.R.)); Ullrich, W.; Gaffal, K. Staatliche Materialpruefungsanstalt, Stuttgart (Germany, F.R.); Siemens A.G., Erlangen (Germany, F.R.); Klein, Schanzlin und Becker A.G., Frankenthal (Germany, F.R.). 1987. (In German). (CONF-8710410–: 13. MPA seminar on safety and reliability of pressure components: the contribution of component and large specimen testing to structural integrity assessment methodology, Stuttgart, Germany, F.R., 8-9 Oct 1987). In *Safety and reliability of pressure components with special emphasis on the contribution of component and large specimen testing to structural integrity assessment methodology. Vol. 2. Pipe failure, components, thermal shock loading, high temperature behaviour, integrity of vessels, integrity of welded joints.* Order Number DE89783126/JAW. Available from NTIS (US Sales Only), PC A99/MF A01.

The main coolant pump YD 10 at the nuclear power station in Goesgen and the pump YD 40 in service at a nuclear power plant in Grafenrheinfeld failed in 1985 and 1986, respectively. In both instances, the shaft fractured in the region of the axial bearing. The defects were analysed and improvements derived. The identified faults have, until now, only occurred at the location of the pump impeller key fixture (impeller root/key groove).

33489 (KFKI–1988-67/G) **Monitoring of the functions of detectors and measurement lines.** Kiss, S.; Por, G. Hungarian Academy of Sciences, Budapest (Hungary). Central Research Inst. for Physics. Nov 1988. 107p. (In Hungarian). Order Number DE89620246/JAW. Available from NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS.

Two measurement series in the Paks Nuclear Power Plant, Hungary, are reported. One was accomplished in order to find out whether the very high temperature of the reactor was due to the erroneous positioning of the thermocouples. It was found out that the indication by the thermocouples of the fuel cassette was not a consequence of positioning. The second series of measurements was performed in order to test the noise diagnostics line in the Unit 3 and Unit 4 of the Paks NPP. (R.P.) 18 figs.

33490 (KFKI–1988-70/G) **Modelling study for the determination of temperature distribution in a WWER-1000 type fuel element.** Gyenes, Gy. Hungarian Academy of Sciences, Budapest (Hungary). Central Research Inst. for Physics. Dec 1988. 36p. (In Hungarian). Order Number DE89620247/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A short description is presented of the fuel element of the WWER-1000 type nuclear reactor. A physical model of the fuel element was developed in order to determine the temperature distribution within the element. The numerical solution of the mathematical model based on the physical model was performed by using the one-dimensional modular program HOVID. The influence of simplifications introduced in the mathematical model on the calculated temperature distribution is discussed. Finally, the results of steady-state calculations are analyzed. (R.P.) 11 refs.; 7 figs.; 4 tabs.

33491 (KFKI–1988-72/G) **Application of the SSYST-3 program system to WWER type nuclear reactors Pt. 1. Preliminary studies.** Molnar, I.; Perneczky, L.; Szabados, L.; Vigassy, J. Hungarian Academy of Sciences, Budapest (Hungary). Central Research Inst. for Physics. Dec 1988. 41p. (In Hungarian). Order Number DE89620248/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A computer code was developed for the simulation of reactor physical, thermohydraulical and chemical processes taking place in WWER-1000 type nuclear reactors. Two versions of this code, the SSYST-2 and SSYST-3 were compared with special attention to their data handling capabilities. The MULTRAN module of the SSYST-3 used for the calculation of Zircaloy fuel cladding oxidation was tested in detail. Some problems concerning the adaptation of SSYST-3 modules to WWER-type reactors were analyzed. 8 refs.; 4 tabs.

33492 (KFKI–1988-73/G) **Design of the PMK-1000 test facility Pt. 1. Conceptual design and modelling principles.** Szabados, L.; Csom, V.; Ezsoel, Gy.; Maroti, L.; Toth, I. Hungarian Academy of Sciences, Budapest (Hungary). Central Research Inst. for Physics. Dec 1988. 55p. (In Hungarian). Order Number DE89620249/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

The PMK-1000 facility (Paks Model Test 1000) is an integral type experimental station for testing and simulating flow processes, natural circulation and failure transients in the Paks Nuclear Power Plant's WWER-1000 type reactor. The basic concepts of the design

are described, and the characteristic dimensions of the test facility with a volume ratio of 1:1375 are determined. The cost estimation of the construction of PMK-1000 is presented. (R.P.) 5 refs.; 20 figs.; 3 tabs.

33493 (SAND–88-1761C) **Shippingport neutron shield tank sampling and analysis program.** Rosinski, S.T.; Shack, W.J. Sandia National Labs., Albuquerque, NM (USA). 1988. 8p. Sponsored by DOE/NE;NRC. DOE Contract AC04-76DP00789;W-31109-ENG-38;AC06-76RL01830. (CONF-890721–2: Joint ASME/JSME pressure vessel and piping conference, Honolulu, Hawaii, USA, 23-27 Jul 1989). Order Number DE89001668/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The US Department of Energy (DOE) and the US Nuclear Regulatory Commission (NRC) are supporting work at Sandia National Laboratories (SNL) and Argonne National Laboratory (ANL), respectively, to obtain disc samples from the Shippingport Station neutron shield tank (NST) and characterize the low-temperature (<90°C), low-flux ($<3 \times 10^9$ n/cm^2·s, E > 1MeV) neutron embrittlement of reactor pressure vessel (RPV) support structures. Pacific Northwest Laboratory (PNL), funded jointly by DOE and NRC, developed and demonstrated the sampling technology. A total of eleven six-inch diameter discs have been removed from the one-inch thick NST inner wall representing base-metal and weld-metal at three fluence levels. Sample preparation and preliminary analysis will be performed by ANL, SNL, and PNL. The sample evaluation plan, developed by ANL and SNL, involves initial composition analysis and neutron exposure level determination of each disc followed by a representative Charpy V-notch test to indicate the extent of embrittlement. The preliminary Charpy results support the decision for a more extensive testing program. Embrittlement of the NST from the low-flux, low-temperature environment has been indicated by an increase in the nil-ductility transition temperature and a decrease in the upper shelf energy as compared to similar material radiated in the High Flux Isotope Reactor (HFIR) under comparable conditions. 7 refs., 2 figs., 3 tabs.

33494 (STUDSVIK-STSR–1) **The Studsvik Super-Ramp Project: Quarterly progress report, April–June, 1980 and July–September, 1980.** Djurle, S. Studsvik Energiteknik AB, Nykoeping (Sweden). Oct 1980. 22p. Sponsored by DOE Nuclear Energy. DOE Contract FG06-80ET34032. Order Number DE89013226/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; GPO Dep.

The first SUPER-RAMP Project Committee Meeting, SR/PCM 1, was organized on June 9, 1980 in Copenhagen, during which the status of the Project was discussed and deliberated as is documented in the minutes of the meeting. The work to resolve the different requests for modifications to the Draft II Agreement still continues. The first transport of test fuel rods for the SUPER-RAMP Project (5 PK4 and 5 PK6 rods) took place in June 1980. Power ramp testing, according to ramp conditions agreed to at SR/PCM 1, was performed on three rods from each of the PK4 and PK6 rod groups during late August to mid-September. Non-destructive pool-side examinations have been performed and have confirmed failure of one of the PK6 rods. 20 refs., 1 tab.

33495 (STUDSVIK-STSR–2) **Results of non-destructive examinations of the fuel rods of the groups PK4 and PK6: The Studsvik Super-Ramp Project.** Bergenlid, U.; Gustafsson, I.; Carlsson, J. Studsvik Energiteknik AB, Nykoeping (Sweden). Dec 1980. 28p. Sponsored by DOE Nuclear Energy. DOE Contract FG06-80ET34032. Order Number DE89013227/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; GPO Dep.

Six fuel rods of the groups PK4 and PK6 (PK = PWR – KWU/CE) were ramp tested in August–September 1980. Measurements of the pre-ramp diameter profiles were performed on 4 of the rods according to the technical program. All rods were measured, radiographed and eddy current tested after the power ramps. The rods are listed below together with the ramp terminal power levels (RTL) and the results as regards no failure or failure (NF/F). The cladding failure of rod No. PK6-1 was confirmed clearly by the EC test and, with a smaller certainty, by the radiography. This document discusses test methods and results. 15 figs., 1 tab.

33496 (STUDSVIK-STSR–3) **The Studsvik Super-Ramp Project: Quarterly progress report, October–December 1980.** Djurle, S. Studsvik Energiteknik AB, Nykoeping (Sweden). Jan 1981. 13p. Sponsored by DOE Nuclear Energy. DOE Contract FG06-80ET34032. Order Number DE89013228/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; GPO Dep.

The work with finalizing the Project Agreement Document has been brought to an end, resulting in the final Project Agreement being submitted for signing on December 4, 1980. During the report period seven Contracting Parties have signed the Agreement. The pool-side nondestructive examinations of the six ramped rods from the rod groups PK4 and PK6 have been completed. The first quarterly progress report covering the pre-project period and the second and third quarter of 1980 has been issued during the report period. 6 refs.

33497 (STUDSVIK-STSR–5) **Test fuel rod fabrication and pre-irradiation characterization report, rod groups PK4 and PK6: The Studsvik Super-Ramp Project.** Dewes, P.; Lorz, E. (comps.). Studsvik Energiteknik AB, Nykoeping (Sweden); Kraftwerk Union A.G., Erlangen (Germany, F.R.). Hauptbereich Brennstoffkreislauf. Jan 1981. 39p. Sponsored by DOE Nuclear Energy. DOE Contract FG06-80ET34032. Order Number DE89013230/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; GPO Dep.

KWU/CE are supplying a total of 16 PWR test fuel rods divided into four groups of different rod design for the Studsvik SUPER-RAMP Project in the years 1980 and 1981. Four rods of group PK 4 (fuel with Gd_2O_3 addition) and four rods of group PK 6 (large grain size fuel) have been delivered to Studsvik in 1980 together with two spare rods (one rod of each design). These rods have been fabricated and characterized during fabrication in the first half of the year 1976 and have been pre-irradiated in the nuclear power plant Obrigheim (KWO) from June 1976 to June 1979. This report presents the data package on fabrication and characterization and manufacturing outline for the rod groups PK 4 and PK 6. 9 figs., 14 tabs.

33498 (STUDSVIK-STSR–6) **Base irradiation history and interim inspection of the KWU/CE test fuel rods of rod groups PK4 and PK6: The SUPER-RAMP Project.** Dewes, P.; Lorz, E. Studsvik Energiteknik AB, Nykoeping (Sweden). [1989]. 31p. Sponsored by DOE Nuclear Energy. DOE Contract FG06-80ET34032. Order Number DE89013231/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; GPO Dep.

A total of 16 PWR type test fuel rods (segments) will be supplied by KWU/CE to the Studsvik SUPER-RAMP Project. The first group of test fuel rods to be supplied in 1980 consists of 4 rods of type PK4 (Gd_2O_3 addition) and 4 rods of type PK6 (large UO_2 grain size) and two additional spare rods, one of each type. These test fuel rods were assembled to segmented rods of standard length and pre-irradiated in the nuclear power plant Obrigheim (Kernkraftwerk Obrigheim = KWO), Germany during three operational cycles from June 1976 to June 1979. After removal from the fuel assembly the segmented rods were taken to the Hot Cells at Karlstein for disassembly and interim inspection prior to the ramp tests at Studsvik. This report presents the detailed pre-irradiation history of the test fuel rods in KWO as well as the results of the interim inspection at Karlstein. 16 figs., 4 tabs.

33499 (STUDSVIK-STSR–7) **The Studsvik Super-Ramp Project: Quarterly progress report, January–March, 1981.** Djurle, S. Studsvik Energiteknik AB, Nykoeping (Sweden). Apr 1981. 20p. Sponsored by DOE Nuclear Energy. DOE Contract FG06-80ET34032. Order Number DE89013232/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; GPO Dep.

The Project activities during the quarter have been performed roughly in accordance with the time schedule given in the Agreement. The Westinghouse test fuel rod groups PW3 and PW5 have been transported to Studsvik. The PW3/1-4 rods have been ramp tested, resulting in two failures and two non-failures. Pre-ramp examinations have been performed on the rod groups PW3 and PW5 and post-ramp non-destructive examinations have been performed on the ramped rods PW3/1-4. Fuel test rod fabrication and pre-irradiation characterization as well as fuel rod base irradiation and interim examination have been reported for the KWU/CE rod groups

PK4 and PK6. A final report for the power ramping of the rods PK4/1-3 and PK6/1-3 has been issued. The non-destructive examinations of the rod groups PK4 and PK6, performed at Studsvik, have been reported. 12 refs.

33500 (STUDSVIK-STSR–9) **Fabrication and characterization of Westinghouse-design fuel rods for The Super-Ramp Project: The Studsvik Super-Ramp Project.** Boyle, R.F.; Stansfield, R. Studsvik Energiteknik AB, Nykoeping (Sweden). Apr 1981. 64p. Sponsored by DOE Nuclear Energy. DOE Contract FG06-80ET34032. Order Number DE89013234/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; GPO Dep.

This report documents the fabrication and characterization for 10 Westinghouse-design fuel rods supplied to the Studsvik SUPER-RAMP Project. Fuel rods being supplied to the SUPER-RAMP Project were initially designed and characterized for a Westinghouse ramp program. The rods were specifically intended for preirradiation in the BR-3 reactor and subsequent ramp testing in a reactor test loop. The 17 × 17 fuel rod diameter Core 4A BR-3 fuel assembly configuration was designed for removal of all 28 fuel rods and reconstitution of the assembly for subsequent irradiation cycles. The fuel was also characterized during fabrication to provide a well-defined base point for subsequent evaluation of power ramp performance. The initial Westinghouse ramp program was begun in 1974; fuel rods were fabricated in 1975 and loaded into assemblies in 1976. Irradiations began in mid-July 1976. Other design information relative to the rods supplied is listed and specific rod identities and the expected EOL heat flux and burnup are provided. The clad material is Westinghouse 17 × 17 design, cold-worked and stress-relief annealed Zircaloy-4 fabricated by the Specialty Metals Division (SMD) of Westinghouse Electric Corporation. 21 figs., 20 tabs.

33501 (STUDSVIK-STSR–10) **Westinghouse test fuel rods: Base irradiation history report: The Super-Ramp Project.** Stansfield, R. (comp.). Studsvik Energiteknik AB, Nykoeping (Sweden); Westinghouse Electric Nuclear Energy Systems Europe (WENESE), Brussels (Belgium). [1989]. 61p. Sponsored by DOE Nuclear Energy. DOE Contract FG06-80ET34032. Order Number DE89013235/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; GPO Dep.

This report contains the PRE RAMP Irradiation Data on the Westinghouse supplied test fuel rods. A brief description of the overall reactor characteristics and the individual rod behavior is given. The Rod Power History and detailed coolant temperature distribution is provided courtesy of BELGO-NUCLEAIRE who performed the fuel management of BR-3 Cores 4A and 4B for CEN/SCK the reactor operator. It is anticipated that the PRE-RAMP characterization of the test fuel rods will provide further information on the test rod condition. 30 figs., 10 tabs.

33502 (STUDSVIK-STSR–13) **The Studsvik Super-Ramp Project: Quarterly progress report, April–June 1981.** Djurle, S. Studsvik Energiteknik AB, Nykoeping (Sweden). Jul 1981. 22p. Sponsored by DOE Nuclear Energy. DOE Contract FG06-80ET34032. Order Number DE89013238/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; GPO Dep.

The Project activities during the quarter have been performed roughly in accordance with the time schedule given in the Agreement. The transport of the rod groups PK1 and PK2 is delayed to the end of July. The rod group BK7 will be shipped together with PK1 and PK2 which means an earlier transport for BK7 than originally scheduled. The data package of fuel rod fabrication and preirradiation characterization has been issued for the rod groups PW3 and PW5. Power ramping has been performed on three of the rods belonging to the rod group PW5. As all three rods failed — a result not foreseen in the ramp test matrix — a new decision is needed about the ramping of the rod PW5/4. Preliminary ramp test data have been given for the rods PW5/1-3 and final data for the rods PW3/1-4, ramped earlier. 11 refs., 2 figs., 2 tabs.

33503 (STUDSVIK-STSR–16) **The Studsvik Super-Ramp Project: Quarterly progress report, July–September 1981.** Djurle, S. Studsvik Energiteknik AB, Nykoeping (Sweden). Oct 1981. 23p. Sponsored by DOE Nuclear Energy. DOE Contract FG06-80ET34032. Order Number DE89013241/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; GPO Dep.

The Project work is behind the time schedule given in the Agreement with regard to the rod groups PK4 and PK6. The transport of the rod groups PK1 and PK2 to Studsvik was delayed, and as this transport was combined with the return transport of the rods PK4/1-3 and PK6/1-3, these rods have come to Karlstein about 5 months later than foreseen. In addition to this the outcome of the power ramp tests has implied that the remaining PK4 and PK6 rods were not ramp tested at the date of the transport. The rod groups PK1, PK2 and BK7 were transported from Karlstein to Studsvik and the rods PK4/1-3 and PK6/1-3 from Studsvik to Karlstein in the last week of July. The data package of fuel rod fabrication and pre-irradiation characterization has been issued for the rod groups PK1, PK2 and BK7. The base irradiation history of the rod groups PK1 and PK2 has been reported. A power ramp campaign started at the end of September and is continuing. 10 refs., 2 figs., 2 tabs.

33504 (STUDSVIK-STSR–18) **The Studsvik Super-Ramp Project: Quarterly progress report, October–December 1981.** Djurle, S. Studsvik Energiteknik AB, Nykoeping (Sweden). Feb 1982. 28p. Sponsored by DOE Nuclear Energy. DOE Contract FG06-80ET34032. Order Number DE89013243/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; GPO Dep.

The Project work is behind the schedule with regard to power ramping of remaining rods from the rod groups PK1, PK2 and PW5 and post-ramp examination at Karlstein of the groups PK1, PK2, PK4 and PK6. During the quarter a group of Swiss utilities has been accepted as a Contracting Party of the SUPER-RAMP Project. The data package for the base irradiation and interim inspection of the rod groups PK1 and PK2 has been issued. Three campaigns of power rampings have taken place, in which the following 17 rods have been tested: PK1/1-3, PK2/1-3, PK4/s, PK6/4,s, BK7/1-3,5-6,8 and BG9/1-2. Rod elongation measurements were performed on most of the rods during ramping. Non-destructive and hot cell examination work have been performed as agreed to at Project Committee Meetings.

33505 (STUDSVIK-STSR–20) **The Studsvik Super-Ramp Project: Quarterly progress report, January–March 1982.** Djurle, S. Studsvik Energiteknik AB, Nykoeping (Sweden). May 1982. 30p. Sponsored by DOE Nuclear Energy. DOE Contract FG06-80ET34032. Order Number DE89013245/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; GPO Dep.

The Project work is behind the schedule with regard to power ramping and post-ramp examination. Due to the fact that the STUDSVIK application for a new R2 operation license has not been approved by the Swedish Government, R2 has not been in operation during the report period. Hence no power rampings have been performed and the delay with regard to ramping has increased as compared to what was noted in the last quarterly progress report. The Fourth Project Committee Meeting was organized in Stockholm on March 8–9, 1982, during which the technical and financial status deliberated. Minutes have been issued from the meeting. The data package for the fabrication, pre-irradiation characterization and irradiation history of GE rods for the SUPER-RAMP Project has been delivered to Studsvik. After reproduction it will be issued as STSR-19. 13 refs., 3 tabs.

33506 (STUDSVIK-STSRX–8) **The Studsvik Super-Ramp Extension Project: Progress report, January 1–September 30, 1984.** Djurle, S. Studsvik Energiteknik AB, Nykoeping (Sweden). Oct 1984. 18p. Sponsored by DOE Nuclear Energy. DOE Contract FG01-84NE34122. Order Number DE89012715/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; GPO Dep.

The Project Agreement has been signed by fourteen Contracting Parties. Seven Parties are expected to sign in the near future. Negotiations are going on with some other organizations. The complementary PIE of SUPER-RAMP test fuel rods have been performed for both the PWR and the BWR subprograms. In the BWR subprogram ten test fuel rods have been delivered from ASEA-ATOM after base irradiation in Oskarshamn II. Six of the rods have undergone slow power ramp testing according to plan after interim examinations were performed. The examination program after ramp testing has been completed except for ceramographic examinations. 17 refs., 1 tab.

2103 Power Reactors, Non-breeding, Graphite Moderated

Refer also to citation(s) 33550, 33551, 33591, 33866, 33867, 33868, 33870, 33885, 34442, 34443, 34444, 34445, 34446, 34447, 34448, 34449, 34450, 34451, 34452, 34453, 34454, 34473, 34474, 34475, 34476, 34477, 34478, 34507, 34510, 34700

33507 (AECL–9424) **Stability analysis of spatial power distribution in RBMK-1000 reactor.** Gulshani, P.; Datur, A.R.; Chexal, B. Atomic Energy of Canada Ltd., Sheridan Park, ON (Canada). CANDU Operations. Dec 1987. 61p. Order Number DE89620259/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

A simple model describing the linearized dynamics of a coupled neutronic and thermohydraulic reactor system was used to analyze the stability of the radial and azimuthal power distribution in the boiling and spatially uncontrolled RBMK-1000 reactor (similar to Chernobyl-4). A parametric survey of stability of the power distribution was carried out over a range of power levels, flowrates and subcriticality of the power spatial modes. The significance of the various feedback mechanisms such as the moderator temperature, void, xenon and doppler reactivity are examined. A map of instability trends in power spatial distribution with the mode subcriticality and the reactor power and flowrate was developed. It is predicted that all lower modes of reactor power spatial distribution of interest are unstable at all conditions in power and flowrate particularly at low power levels and flowrates.

33508 (CEGB-TPRD/L–3256/R88) **Oxide deposition in the orifices of AGR boiler inlet ferrule assemblies.** Thomas, D.M. Central Electricity Research Labs., Leatherhead (UK). Aug 1988. 61p. Order Number DE89618233/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

In experiments designed to study the erosion-corrosion behaviour of AGR boiler inlet ferrules using the CERL high velocity circulating isothermal water rig, oxide deposition was frequently found within the flow control orifices. The present investigation was carried out as a preliminary to a programme of experiments addressed specifically to this problem. Analysis shows the deposits to be predominantly magnetite (or possible maghemite) with traces of α-haematite. Calculations indicate that the maximum rate of magnetite deposition is mass transfer limited, although in some experiments no deposition occurred in cases where mass transfer would have allowed substantial deposition. Thus the occurrence of deposition is thought to depend on the rig potential as this varies with experimental conditions. In these experiments the surface potential is not found to be governed by the hydrogen level. Metallographic cross-sections through the ferrule control bores show the deposits to be found in regions of separated flow, and the flow markings in the deposits show that the flow is turbulent in these zones. The exact morphology is thought to be influenced by machining marks within the control bore.

33509 (KURRI-TR–305, pp. 61-71) **Research on reactor physics using the Very High Temperature Reactor Critical Assembly (VHTRC).** Akino, Fujiyoshi (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst. Jul 1988. (In Japanese). (CONF-8711251–: Seminar on reactor physics experiments with critical assemblies, Kyoto, Japan, 26 Nov 1987). In *Proceedings of the seminar on reactor physics experiments with critical assemblies.* Order Number DE89003363/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

The High Temperature Engineering Test Reactor (HTTR), of which the research and development are advanced by Japan Atomic Energy Research Institute, is planned to apply for the permission of installation in fiscal year 1988, and to start the construction in the latter half of fisical year 1989. As the duty of reactor physics research, the accuracy of the nuclear data is to be confirmed, the validity of the nuclear design techniques is to be inspected, and the nuclear safety of the HTTR core design is to be verified. Therefore, by using the VHTRC, the experimental data of the reactor physics quantities are acquired, such as critical mass, the reactivity worth of simulated control rods and burnable poison rods, the temperature factor of reactivity, power distribution and so on, and the experiment and analysis are advanced. The cores built up in the VHTRC so far were three kinds having different lattice forms and degrees of uranium enrichment. The calculated critical mass was smaller by 1-5 % than the measured values. As to the power distribution and the reactivity worth of burnable poison rods, the prospect of satisfying the required accuracy for the design of the HTTR core was obtained. The experiment using a new core having axially different enrichment degree is planned. (K.I.).

2104 Power Reactors, Non-breeding, Otherwise Moderated Or Unmoderated

Refer also to citation(s) 33226, 33808

33510 (AECL–7542) **Fast fracture of a zirconium alloy pressure tube: cause and implications.** Price, E.G.; Cheadle, B.A. Atomic Energy of Canada Ltd., Sheridan Park, ON (Canada). CANDU Operations. Dec 1985. 11p. (CONF-851203–: International conference and exhibition on fatigue, corrosion cracking, fracture mechanic and failure analysis, Salt Lake City, Utah, USA, 2-6 Dec 1985). Order Number DE89620261/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The cause of the unstable fracture of a Zircaloy-2 pressure tube in the core of a CANDU reactor is reviewed. Failure was associated with the presence of brittle zones of zirconium hydride which developed as a result of thermal gradient induced hydrogen diffusion. Unstable fracture occurred when the partial thickness crack reached an unstable length and the crack ran 2 meters along the tube and terminated by circumferential tearing. The partial thickness defect initiated and propagated to an unstable length by delayed hydride cracking is high compared to fatigue progression and increases exponentially with temperature. Delayed hydride cracking can be prevented by reducing residual stresses to a minimum and by high standards of non-destructive testing that ensures freedom from unacceptable defects. Future prevention of fast fracture is based upon the inspection of a limited number of fuel channels for the presence of defects and for conditions which can cause hydride build-up together with the periodic removal of Zr-2.5wt% Nb tubes to monitor their condition.

2105 Power Reactors, Breeding

Refer also to citation(s) 33226, 33531, 33865

33511 (ANL-FRA–163) **The neutronic and fuel cycle performance of interchangeable 3500 MWth metal and oxide fueled LMRs.** Fujita, E.K.; Wade, D.C. Argonne National Lab., IL (USA). Mar 1989. 63p. Sponsored by DOE Nuclear Energy. DOE Contract W-31109-ENG-38. Order Number DE89012581/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

This study summarizes the neutronic and fuel cycle analysis performed at Argonne National Laboratory for an oxide and a metal fueled 3500 MWth LMR. The oxide and metal core designs were developed to meet reactor performance specifications that are constrained by requirements for core loading interchangeability and for small burnup reactivity swing. Differences in the computed performance parameters of the oxide and metal cores, arising from basic differences in their neutronic characteristics, were identified and discussed. It is shown that metal and oxide cores designed to the same ground rules exhibit many similar performance characteristics; however, they differ substantially in reactivity coefficients, control strategies, and fuel cycle options. 12 refs., 25 figs.

33512 (ANL-FRA–164) **The steady-state thermal-hydraulic performance of 3500 MWth metal and oxide fueled LMRs.** Vilim, R.B.; Hill, R.N. Argonne National Lab., IL (USA). Mar 1989. 49p. Sponsored by DOE Nuclear Energy. DOE Contract W-31109-ENG-38. Order Number DE89012772/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

The thermal-hydraulic performance of a 3500 MWth metal and oxide fueled LMR is reported. Orifice zones are defined and coolant flowrates are given for use in safety analyses. The flux calculations were carried out in three-dimensional hexagonal-Z geometry using a finite differenced diffusion theory code. The heating calculations included the transport and deposition of gamma energy. The

assembly temperature calculations were performed using a subchannel code.

33513 (CEA-CONF–9700) **Fluid structure interaction due to fluid communications between fluid volumes. Application to seismic behaviour of F.B.R. vessels.** Durandet, E.; Gibert, R.J.; Gantenbein, F. CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Etudes Mecaniques et Thermiques. 1988. 27p. (CONF-8806217–: ASME pressure vessel and piping conference: vibration and seismic response of fluid-structure systems, Pittsburgh, Pennsylvania, USA, 19-23 Jun 1988). Order Number DE89760603/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The internal structures of a pool-type breeder reactor are mainly axisymmetric shells separated by fluid volumes which are connected one to another by small communications. Unfortunately, the communications destroy the axisymmetry of the problem and a correct modelisation by finite element method generally need a lot of small elements compared to the size of the standard mesh of the fluid volumes. To overcome these difficulties, an equivalent axisymmetric element based on a local tridimensional solution in the vicinity of the fluid communication is defined and will be described in the paper. This special fluid element is characterized by an equivalent length and annular cross-section. The second part of the paper is devoted to the application to an horizontal seismic calculation of breeder reactor.

33514 (CEGB-RD/B–6041/R88) **Carburisation of stainless steel caused by oil in sodium.** Hobdell, M.R.; Skyrme, G. Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs. Jun 1988. 79p. Order Number DE89618239/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

The primary objectives of this work were to investigate the kinetics of austenitic stainless steel carburisation in sodium caused by oil in sodium, and to measure the corresponding 'sodium carbon activity' (a quantitative measure of sodium steel carburisation potential). For comparative purposes, the steel carburising effects of chemically simpler carbon sources have also been studied. The specific experimental investigations have involved: (i) A study of the kinetics of stainless steel carburisation at 550^{0}C caused by oil in sodium; (ii) A determination of the effective steel carburisation potential (carbon activity) arising from oil ingress, and its persistence with time, and (iii) A comparison of oil and chemically simpler carbon sources, namely graphite and cementite (as carburised iron, Fe-Fe_3C), with regard to both kinetics of steel carburisation and sodium carbon activities produced. In all cases, the nature and extent of carburisation has been determined by optical metallography, X-ray and nuclear microprobe analysis. Preliminary studies on the mutual effect of steel surfaces in close proximity have also been conducted. Previous studies on steel carburisation in sodium are outlined, and the present results are discussed in the context of available thermodynamic and kinetic data pertaining to the carbon-steel and carbon-sodium systems.

33515 (FRNC-TH–3411) **Contribution at the study of by pass turbine lines of thermal or nuclear power plants.** Bentolila, C. Institut National des Sciences Appliquees (INSA), 69 - Villeurbanne (France). Jul 1988. 204p. (In French). Order Number DE89781579/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

The objective of this thesis is to understand and to interpret the complex structure of transitories flows met by rapid expansion of dry steam in turbine bypass. The first chapter gives the general condition of the turbine bypass, the role and the operating conditions. Each part, taken in account separately, is described and permits to situate their particularities. The second chapter concerns the instationary one dimensional study of the flow in order to situate quantitatively the pressure, the temperature and the Mach number. The third chapter concerns the tests realized on mockup in order to put in clearness some large parameters such as diaphragm structure, lenghts and expansion chamber shapes. The last chapter concerns a more elaborate study on one expansion stage in terms of enter diaphragm geometry, number of holes, cylindrical or rectangular shape. This study in two dimensional flows, has for objective to specify the flow structure of supersonic jet on flat wall.

33516 (IAEA-INFCIRC–351(Add.1)) **Communications received from Argentina and Brazil.** International Atomic Energy Agency, Vienna (Austria). Jan 1989. 2p. Order Number DE89620441/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Hard copies are available in English, Portuguese and Spanish from IAEA Division of Publications, Distribution Unit.

The document reproduces the Joint Statement on Nuclear Policy signed by the President of Argentina and the President of Brazil on 29 November 1988 at Ezeiza, Argentina, concerning the decision of the two countries to undertake a joint fast breeder reactor project.

33517 (LA-UR–89-1772) **Calibration parameters from Monte Carlo simulations for neutron coincidence assay of MOX [mixed oxide] fuel elements: A substitute for standards?.** Stewart, J.E.; Ferran, R.R.; Simmonds, S.M.; Menlove, H.O. Los Alamos National Lab., NM (USA). 1989. 8p. Sponsored by DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-890565–6: 11. annual ESARDA symposium on safeguards and nuclear materials management, , Luxembourg, 30 May - 1 jun 1989). Order Number DE89013460/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Results from application of a calculational model for the two- parameter (singles and doubles) passive neutron coincidence assay of finished Fast Breeder Reactor (FBR) subassemblies are compared with calibration measurements. Two assay instruments are considered; the Universal Fast Breeder Reactor Subassembly Counter (UFBC) and the Capsule Counter installed at the Japanese Plutonium Fuel Production Facility (PFPF). In the case of US Fast Flux Test Facility (FFTF) fuel, the absolute ratio of calculations to measurements for the multiplication-corrected coincidence calibration constant is +1.1 $\pm$ 1.0% (average of four subassemblies) for the UFBC and −1.3 $\pm$ 0.6% (average of five subassemblies) for the Capsule Counter. For initial measurements of Japanese fuel in the Capsule Counter, the absolute ratio is −1.0 $\pm$ 0.7% for three JOYO subassemblies and +0.8 $\pm$ 0.7% for one MONJU subassembly. Calculations of relative effects such as the change in coincidence response from, for example, subassembly can thickness of U enrichment are more accurate (better than 0.5%) than absolute calibration parameters. This very good accuracy offers more effective and less costly inspector verification of finished FBR fuel elements by reducing reliance on physical standards to expand the cross-calibration databases. 11 refs., 8 figs., 5 tabs.

33518 (ORNL–6546) **High-temperature flaw assessment procedure: A state-of-the-art survey.** Ruggles, M.B.; Takahashi, Y. Oak Ridge National Lab., TN (USA). May 1989. 68p. Sponsored by DOE Nuclear Energy. DOE Contract AC05-84OR21400. Order Number DE89012740/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

High-temperature crack growth under cyclic, static, and combined loading is received with an emphasis on fracture mechanics aspects. Experimental studies of the effects of loading history, microstructure, temperature, and environment on crack growth behavior are described and interpreted. The experimental evidence is used to examine crack growth parameters and theoretical models for fatigue, creep, and creep-fatigue crack propagation at elevated temperatures. The limitations of both elastic and elastic-plastic fracture mechanics for high-temperature subcritical crack growth are assessed. Existing techniques for modeling critical crack growth/ligament instability failure are also presented. Related topics of defect modeling and engineering flaw assessment procedures, nondestructive evaluation methods, and probabilistic failure analysis are briefly discussed. 142 refs., 33 figs.

33519 Demonstration of EBR-II power maneuvers without control rod movement. Chang, L.K. (Argonne National Lab., IL (USA)); Mohr, D.; Planchon, H.P.; Feldman, E.E.; Messick, N.C. *Nuclear Engineering and Design (Netherlands),* 113(1): 141-148 (Apr 1989). DOE Contract W-31-109-ENG-38.

A group of five plant inherent control tests was successfully conducted in November 1987 in the Experimental Breeder Reactor II. These tests demonstrated that the plant power of a metal-fueled reactor can be passively controlled over a large power range by slowly changing the primary flow and the reactor inlet temperature. These variables are, in turn, regulated by the primary pump speed,

the secondary flow, and the turbine inlet pressure. In all tests, control rods were not used to regulate power. It was demonstrated that the plant power can be controlled with reasonable accuracy without using control rods when the ractivity feedback characteristics of the reactor are well understood and the plant controllers are adequately designed.

2106 Power Reactors, Auxiliary, Mobile, Package, and Transportable

33520 (JAERI-M--88-244) **Experimental study on the critical heat flux in a varying acceleration field, (1). The influence of varying acceleration on the behavior of bubble in subcool boiling, 2: behavior of bubbles under stationary acceleration field and varying acceleration field.** Kusunoki, Tsuyoshi; Yokomura, Takeyoshi; Otsuji, Tomoo; Ikawa, Masahiro; Kurosawa, Akira. Japan Atomic Energy Research Inst., Tokyo (Japan). Dec 1988. 43p. (In Japanese). Order Number DE89778070/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

It is very important for the thermohydraulic design and for the safety assesement of marine reactors, to understand the effect of varying acceleration induced by ship motion on critical heart flux. The purpose of this joint study is to examine quantitatively the influence of varying acceleration on the behavior of bubbles. In the experiment, FREON-113 was used as working fluid. This report describes some experimental results; measurements of void fraction and bubble velocity near the heat transfer surface, measurement of bubble size under stationary acceleration field and observation of bubble behavior under varying acceleration field.

2107 Regulation and Licensing

Refer also to citation(s) 33332, 33539, 35200

33521 (INIS-BR--1550) **Function of specialized organization in work safety engineering for nuclear installations.** Salvatore, J.E.L. Comissao Nacional de Energia Nuclear, Rio de Janeiro, RJ (Brazil). [1989]. 12p. (In Portuguese). Order Number DE89620440/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The attributions of Brazilian CNEN in the licensing procedures of any nuclear installation are discussed. It is shown that the work safety engineering and industrial safety constitute important functions for nuclear safety. (M.C.K.).

33522 (NUREG--0304-Vol.13-No.4) **Regulatory and technical reports (Abstract Index Journal): Annual compilation for 1988.** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Freedom of Information and Publications Services. May 1989. 133p. Sponsored by Nuclear Regulatory Commission. Available from NTIS, PC A07/MF A01 - GPO - OSTI.

This journal includes all formal reports in the NUREG series prepared by the NRC staff and contractors; proceedings of conferences and workshops; as well as international agreement reports. The entries in this compilation are indexed for access by title and abstract, secondary report number, personal author, subject, NRC organization for staff and international agreements, contractor, international organization, and licensed facility.

33523 (NUREG/CR--2000-Vol.8-No.4) **Licensee Event Report (LER) compilation for month of April 1989.** Nuclear Regulatory Commission, Washington, DC (USA). Office for Analysis and Evaluation of Operational Data; Oak Ridge National Lab., TN (USA). May 1989. 177p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC05-84OR21400. (ORNL/NSIC--200-Vol.8-No.4). Available from NTIS, PC A09/MF A01 - GPO - OSTI.

This monthly report contains Licensee Event Report (LER) operational information that was processed into the LER data file of the Nuclear Safety Information Center (NSIC) during the one month period identified on the cover of the document. The LERs, from which this information is derived, are submitted to the Nuclear Regulatory Commission (NRC) by nuclear power plant licensees in accordance with federal regulations. Procedures for LER reporting for revisions to those events occurring prior to 1984 are described in NRC Regulatory Guide 1.16 and NUREG-0161, Instructions for Preparation of Data Entry Sheets for Licensee Event Reports. For those events occurring on and after January 1, 1984, LERs are being submitted in accordance with the revised rule contained in Title 10 Part 50.73 of the Code of Federal Regulations (10 CFR 50.73 – Licensee Event Report System) which was published in the Federal Register (Vol. 48, No. 144) on July 26, 1983. NUREG-1022, Licensee Event Report System – Description of Systems and Guidelines for reporting, provides supporting guidance and information on the revised LER rule.

33524 (SAND--88-2203C) **Applications of license renewal evaluation methodology to identify key components for generic life assessment.** Carlson, D.D. Sandia National Labs., Albuquerque, NM (USA). 1988. 11p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890721--3: Joint ASME/JSME pressure vessel and piping conference, Honolulu, Hawaii, USA, 23-27 Jul 1989). Order Number DE89001666/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The review and evaluation of plant equipment for nuclear power plant license renewal differ from the initial licensing of the plant. A substantial operating history has been established, the licensing basis has evolved from the original one, and plant equipment has been subject to periodic maintenance and surveillance throughout its life. With the sponsorship of the Department of Energy and under the auspices of the Nuclear Management and Resources Council (NUMARC) Nuclear Utilities Plant Life Extension (NUPLEX) Working Group, the industry has developed a systematic approach to identify and evaluate plant equipment for license renewal. The approach focuses the review and evaluation on those safety-significant systems and components subject to age-related degradation that are not subject to recognized effective replacement, refurbishment, or inspection programs. 1 fig., 2 tabs.

33525 (SSI--88-08) **Decommissioning nuclear power plants: authority and policy issues.** Bergman, C. National Inst. of Radiation Protection, Stockholm (Sweden). 18 Apr 1988. 11p. (In Swedish). Order Number DE89618361/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The present laws provide authorities with control of all aspects of radiological protection and safety in connection with decommissioning of nuclear power plants. However a law modification is needed if an earlier action than 2010 is claimed. Several reasons speak for decommissioning in close connection to reactor closing. Before any steps are taken it is however necessary to have an ultimate storage in operation for decommissioning wastes. Although there is today technique available that is sufficiently well established for decommissioning nuclear power plants, there are still reasons to adapt it to the specific Swedish circumstances. Also in other fields there are reasons for research and development. (O.S.).

2108 Economics

33526 (CNEA--491) **Nuclear power production costs.** Informe. Erramuspe, H.J. Comision Nacional de Energia Atomica, Buenos Aires (Argentina). 1988. 12p. (In Spanish). Order Number DE89620430/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Informe.

The economic competitiveness of nuclear power in different highly developed countries is shown, by reviewing various international studies made on the subject. Generation costs (historical values) of Atucha I and Embalse Nuclear Power Plants, which are of the type used in those countries, are also included. The results of an international study on the economic aspects of the back end of the nuclear fuel cycle are also reviewed. This study shows its relatively low incidence in the generation costs. The conclusion is that if in Argentina the same principles of economic rationality were followed, nuclear energy would be economically competitive in the future, as it is today. This is of great importance in view of its almost unavoidable character of alternative source of energy, and specially since we have to expect an important growth in the consumption of electricity, due to its low share in the total consumption of energy, and the low energy consumption per capita in Argentina.

33527 (CNEA–492) **Construction times and the decommissioning of nuclear power plants.** Informe. Erramuspe, H.J. Comision Nacional de Energia Atomica, Buenos Aires (Argentina). 1988. 27p. (In Spanish). Order Number DE89620241/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Informe.; Also published in Rev. Argent. Nucl. (Mar-Abr 1988). v. 2(13) p. 46-62.

The construction and the decommissioning periods of nuclear power plants (NPP), are studied, due to their importance in the generation costs. With reference to the construction periods of these plants, a review is made of the situation and technical improvements made in different countries, with the purpose of shortening them. In regard to the decommissioning of NPP, the present and future situations are reviewed in connection with different stages of decommissioning and their related problems, as the residual radioactivity of different components, and the size of the final wastes to be disposed of. The possibilities of plant life extensions are also revised in connection with these problems. Finally, the expected decommissioning costs are analyzed.

33528 (JAERI-M–88-263) **OECD/IEA/ETSAP energy-environment systems analysis. Towards fossil-nuclear symbiosis.** Yasukawa, Shigeru; Sato, Osamu; Tadokoro, Yoshihiro; Nagano, Takao; Shiraki, Hajimu; Shimoyamada, Yoshinori. Japan Atomic Energy Research Inst., Tokyo (Japan). Dec 1988. 65p. Order Number DE89778096/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

Fuel supply and demand mix as well as energy technology configuration are analyzed by the MARKAL model for the future Japanese energy system, when reduction of environmental emissions is taken into consideration. The Reference Energy System (RES) covers whole sectors, i.e., fuel conversion and energy transformation, industry, residential and commercial, and transportation sectors. Environmental emissions considered here are SOx, NOx, CO_2, and radio activity, and the time horizon is an interval from 1985 to 2030. Both SOx and NOx emission can be reduced much by present art of reduction measures. From the view points of cost effectiveness, abatement technologies including fluegas treatments take the highest priority and fuel switching and technology substitution follow in this order. For CO_2 reduction, both nuclear and renewable energy technologies are essential among them.

22 NUCLEAR REACTOR TECHNOLOGY

2201 Theory and Calculation

33529 (CTA-IEAv-RI–001/83) **Modifications in the UNIMUG computer code (Addendum to technical note EAV/NT–003/80).** Alcantara, H.G. de; Rosa, M.A.P. Centro Tecnico Aeroespacial, Sao Jose dos Campos, SP (Brazil). Inst. de Estudos Avancados. 5 May 1983. 16p. (In Portuguese). Order Number DE89620448/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The modifications done in the UNIMUG computer code are described. The UNIMUG-VERSION 3 has options for condensating macroscopic cross sections in regions and microscopic cross sections of isotopes contained in each region. The code also calculates: spectral index, ratio between two specificated reactions of chosen isotopes in indicated groups and regions, average buckling by region/group, by region, reactor buckling and average flux of reactor. The code has no restrictions for number of regions, number of groups, number of intervals, and table size of macroscopic and microscopic cross sections. (M.C.K.).

33530 (INIS-SU–78, pp. 297) **Perturbation theory for the equations of isotope burnup.** Rajkin, M.S. (AN SSSR, Leningrad (USSR). Inst. Yadernoj Fiziki); Shlyakhter, A.I. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij. 1988. (In Russian). (CONF-870959–: 1. international conference on neutron physics, Kiev, USSR, 14-18 Sep 1987). In *Neutron physics. Vol. 2.* Order Number DE89012115/JAW. Available from NTIS (US Sales Only), PC A16/MF A01; INIS.

REACTOR KINETICS EQUATIONS/perturbation theory; BURNUP; ITERATIVE METHODS; RADIOACTIVITY; RADIOISOTOPES; TIME DEPENDENCE

33531 (JAERI-M–89-026) **Proceedings of the 1988 seminar on nuclear data.** Nakagawa, Ed. Tsuneo; Zukeran, Atsushi. Japanese Nuclear Data Committee, Tokai, Ibaraki (Japan). c Mar 1989. 359p. (NEANDC(J)–133U;INDC(JPN)–120/L;CONF-881290–: Seminar on nuclear data, Tokai, Japan, 8-9 Dec 1988). Available from Japan Atomic Energy Research Institute, Tokai-mura, Naka-gun, Ibaraki-ken 319-11, Japan.

The 1988 Seminar on Nuclear Data was held at Tokai Research Establishment of Japan Atomic Energy Research Institute, on December 8 and 9, 1988. This Seminar was organized by Japanese Nuclear Data Committee (JNDC) and Nuclear Data Center, JAERI. In an oral session reviews of activities of JNDC and status of JENDL-3 were presented and problems on adjustment of cross-section data were discussed in connection with JENDL-3. In addition, several topical talks were also given. In a poster session, eighteen papers on evaluation and measurement were presented and fruitful discussions were made. In this proceedings, thirty-six papers given in the seminar are compiled.

33532 (KURRI-TR–305, pp. 56-60) **Research on reactor physics using the NAIG Critical Assembly (NCA).** Tanzawa, Tomio (Nippon Atomic Industry Group Co. Ltd., Kawasaki, Kanagawa (Japan). Nuclear Research Lab.). Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst. Jul 1988. (In Japanese). (CONF-8711251–: Seminar on reactor physics experiments with critical assemblies, Kyoto, Japan, 26 Nov 1987). In *Proceedings of the seminar on reactor physics experiments with critical assemblies.* Order Number DE89003363/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

ZERO POWER REACTORS/reactor physics; BWR TYPE REACTORS; REACTOR CORES; CONTROL ELEMENTS; FUEL ASSEMBLIES; POWER DISTRIBUTION; GADOLINIUM OXIDES; CRITICALITY; REACTIVITY; LIFETIME

2202 Components and Accessories

Refer also to citation(s) 33458, 33566, 33588, 33807, 33863, 33864, 33871, 33873, 33874, 33875, 33876, 33877, 33878, 33883, 33981, 34179, 34190, 34191, 34192, 34193, 34194, 34197, 34198, 34200, 34201, 34203, 34209

33533 (EPRI-NP–6390) **Robots to support radioactive waste activities: Task analysis, conceptual design, and commercial evaluation.** Colborn, K.A.; Eckert, R.J.; Lefkowitz, S. Electric Power Research Inst., Palo Alto, CA (USA); Pentek, Inc., Coraopolis, PA (USA). c Jun 1989. 78p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The techniques for handling, storing, and disposing of low level radwaste were evaluated to determine how the cost burden and radiation dose associated with these activities can be reduced. This research project identifies opportunities for using robotics to support radwaste activities. This report documents a methodology to identify tasks with the greatest potential for automation using a semi-quantitative analysis technique. The tasks selected from this analysis were evaluated further by a panel of utility advisors; their input also helped determine the commercial viability of robots to perform the selected tasks. The results of detailed cost-benefit analyses performed for the three highest priority tasks for automation are presented, and conceptual designs for equipment to perform these tasks are also included. The report recommends the development of a reactor cavity decontamination robot to improve radwaste activities at nuclear power plants. 11 refs., 15 figs., 3 tabs.

33534 (IBK–1606) **Empirical intensity of PWR primary coolant pumps failure and repair.** Milivojevicj, S.; Riznicj, J. Institut za Nuklearne Nauke Boris Kidric, Belgrade (Yugoslavia). 1988. 8p. Order Number DE89618192/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Abstract in Serbo-Croat.

The wealth of operating experience concerning PWR type and nuclear reactors that has been regularly monitored and systematically processes since 1971, enabled an analysis of the PWR primary coolant pumps operation. Failure intensity α and repair intensity μ of the pump during its working life were calculated, as these values are necessary in order to determine the reliability and availability of the pump as the basis for analyzing its effect on the safety and efficiency of the nuclear power plant. The trend of failure intensity α follows the theoretically expected changes in α over time, and this is around 10^{-5} in the majority of life-time. Repair intensity μ indicates a slow rise during life-time, i.e. its faster return to operation. (author).7 refs.; 5 figs.

33535 (INIS-mf–11982, pp. 3.1-3.24) **On the transferability of fracture mechanics parameters from specimens to structures using FEM.** Brocks, W. (Bundesanstalt fuer Materialforschung und -pruefung, Berlin (Germany, F.R.)); Kuenecke, G.; Noack, H.D.; Veith, H. Staatliche Materialpruefungsanstalt, Stuttgart (Germany, F.R.); Bundesanstalt fuer Materialforschung und -pruefung, Berlin (Germany, F.R.). 1987. (In German). (CONF-8710410–: 13. MPA seminar on safety and reliability of pressure components: the contribution of component and large specimen testing to structural integrity assessment methodology, Stuttgart, Germany, F.R., 8-9 Oct 1987). In *Safety and reliability of pressure components with special emphasis on the contribution of component and large specimen testing to structural integrity assessment methodology. Vol. 1. Fracture mechanics, dynamic loading, nondestructive testing, radiation embrittlement.* Order Number DE89783126/JAW. Available from NTIS (US Sales Only), PC A99/MF A01.

The influence of the specimen size of CT samples and the specimen geometry of CT, DEC and CC samples was investigated using the results of two and three-dimensional elastic-plastic FEM analyses. The dependences of the crack-opening stress σ_{yy} and the ratio of σ_m to v. Mises reduced stress σ_v at the crack tip on the stress parameter J or δ_t are particularly examined. Furthermore, the relationship between these results and those of a semi-elliptic internal surface crack within a pipe or pressure vessel are also investigated.

33536 (INIS-mf–11982, pp. 4.1-4.24) **Validation of fracture mechanics assessment procedures by large scale specimen.** Roos, E. (Stuttgart Univ. (Germany, F.R.). Staatliche Materialpruefungsanstalt); Bhongbhibhat, T.; Eckert, W.; Eisele, U.; Silcher, H. Staatliche Materialpruefungsanstalt, Stuttgart (Germany, F.R.). 1987. (In German). (CONF-8710410–: 13. MPA seminar on safety and reliability of pressure components: the contribution of component and large specimen testing to structural integrity assessment methodology, Stuttgart, Germany, F.R., 8-9 Oct 1987). In *Safety and reliability of pressure components with special emphasis on the contribution of component and large specimen testing to structural integrity assessment methodology. Vol. 1. Fracture mechanics, dynamic loading, nondestructive testing, radiation embrittlement.* Order Number DE89783126/JAW. Available from NTIS (US Sales Only), PC A99/MF A01.

Depending on the material characteristics and specimen geometry, fracture generally follows a more or less large plastic deformation. Depending on the spread of the plastic zone, one distinguishes between the concepts of linear-elastic and elastic-plastic fracture mechanics. For this, the R-curve method, the R6 method, the failure assessment diagram and the COD concept are examined as methods of approximation. The determination of the trend of the multi-axiality quotient of particular stress states by FE-analysis delivers additional information concerning the anticipated fracture behaviour.

33537 (INIS-mf–11982, pp. 7.1-7.17) **Influence of the triaxiality on stable crack growth.** Kordisch, H. (Fraunhofer-Institut fuer Werkstoffmechanik, Freiburg im Breisgau (Germany, F.R.)); Sommer, E.; Schmitt, W. Staatliche Materialpruefungsanstalt, Stuttgart (Germany, F.R.); Fraunhofer-Institut fuer Werkstoffmechanik, Freiburg im Breisgau (Germany, F.R.). 1987. (In German). (CONF-8710410–: 13. MPA seminar on safety and reliability of pressure components: the contribution of component and large specimen testing to structural integrity assessment methodology, Stuttgart, Germany, F.R., 8-9 Oct 1987). In *Safety and reliability of pressure components with special emphasis on the contribution of component and large specimen testing to structural integrity assessment methodology. Vol. 1. Fracture mechanics, dynamic loading, nondestructive testing, radiation embrittlement.* Order Number DE89783126/JAW. Available from NTIS (US Sales Only), PC A99/MF A01.

The experiments in the ductile fracture range for compact specimens with and without lateral notches are numerically simulated using a three dimensional elastic-plastic finite element analysis. In additions, a model is derived for the correlation between the triaxiality coefficient and the material resistance. This model is finally used to predict the stable crack growth of a realistic surface crack in a tensile test specimen, the results then being compared with experimental data and discussed.

33538 (NKS–88-7, pp. 20-21) **Material technology, MAT-500.** Toerroenen, K. (VTT (Finland)). Nordisk Kontaktorgan for Atomenergispoergsmaal, Risoe (Denmark). Nov 1988. (In Swedish). In *Nordic projects concerning nuclear safety. Report for January-June 1988.* Order Number DE89618061/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Investigation of forms of corrosion and of fracture mechanics in relation to reactor components. (AB).

33539 (SAND–88-2209C) **Technical, economic, and institutional issues affecting the life extension of cables.** Bustard, L.D.; DuCharme, A.R.; Jacobus, M.J. Sandia National Labs., Albuquerque, NM (USA). 1989. 15p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890721–6: Joint ASME/JSME pressure vessel and piping conference, Honolulu, Hawaii, USA, 23-27 Jul 1989). Order Number DE89005234/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

NRC regulations and industry standards provide flexibility to the nuclear industry for demonstrating cable design life goals. Allowable methods for qualifying in-containment cables include laboratory type testing, reference to operating experience, analysis, and combinations of the above. In practice most utilities have used laboratory type testing as the primary method for demonstrating cable life assurance. These tests are frequently performed prior to initial plant operation and include a laboratory accelerated test (lasting a few weeks to a few months) to demonstrate that a cable will function during accident conditions that might occur anytime during a 40-year plant life. Type test rigor and documentation depend strongly on specific utility commitments to satisfy various vintages of standards and implementing regulations. For plant operation beyond 40 years, demonstration of continued cable qualification will be necessary. This might be accomplished by reanalysis of the original qualification basis, by supplementing the original qualification basis with additional laboratory test data, by supplementing the original qualification basis with operational experience, by a combination of the above techniques, or by a cable replacement program. 22 refs., 1 tab.

33540 (SKI–86151-1) **Deterministic and probabilistic model for oilspill fires in nuclear power plants. A final report to the Swedish Nuclear Power Inspectorate.** Karlsson, B. Swedish Nuclear Power Inspectorate, Stockholm (Sweden). Mar 1988. 57p. Order Number DE89618194/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

With Swedish summary.

A deterministic and probabilistic model for oilspill fires in nuclear power plant compartments has been developed. It's objective is to predict whether certain components in the compartment will cease to function as a result of the fire and to give the probability of failure. Results are presented for several scenarios in two compartments. The model has been implimented in the computer code OSFIC, a tool for safety engineers to compare various component configurations in different compartments.

33541 (SKI–86151-2) **Users' guide to OSFIC. A computer program for oilspill fires in compartments.** Karlsson, B. Swedish Nuclear Power Inspectorate, Stockholm (Sweden). May 1988. 46p. Order Number DE89618195/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The document is a description of the computer code OSFIC. The development of the code was made in an effort to develop useful tools for fire analyses in nuclear power plants. The name OSFIC

stands for 'OilSpill Fires In Compartments'. The purpose of this paper is to describe the code and to facilitate the use of the computer program. A more detailed description of the model, it's purpose and the physics involved is given in a separate paper. OSFIC is written in ANSI'77 FORTRAN, it consists of 1 main program, 12 subroutines and 2 functions. It has around 1500 lines of code, including comments. The compiled program is 295 kilobytes long when compiled with the RM FORTRAN compiler on an IBM PC computer.

2203 Fuel Elements

Refer also to citation(s) 33246

33542 (ORNL–6539) **Summary report on the HFED [High-Uranium-Loaded Fuel Element Development] miniplate irradiations for the RERTR [Reduced Enrichment Research and Test Reactor] Program.** Senn, R.L. Oak Ridge National Lab., TN (USA). Apr 1989. 62p. Sponsored by DOE Nuclear Energy. DOE Contract AC05-84OR21400. Order Number DE89012904/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

An experiment to evaluate the irradiation characteristics of various candidate low-enriched, high-uranium content fuels for research and test reactors was performed for the US Department of Energy Reduced Enrichment Research and Test Reactor Program. The experiment included the irradiation of 244 miniature fuel plates (miniplates) in a core position in the Oak Ridge Research Reactor. The miniplates were aluminum-based, dispersion-type plates 114.3 mm long by 50.8 mm wide with overall plate thicknesses of 1.27 or 1.52 mm. Fuel core dimensions varied according to the overall plate thicknesses with a minimum clad thickness of 0.20 mm. Tested fuels included UAl_x, UAl_2, U_3O_8, U_3SiAl, U_3Si, $U_3Si_{1.5}$, U_3Si_2, U_3SiCu, USi, U_6Fe, and $U_6Mn_{1.3}$ materials. Although most miniplates were made with low-enriched uranium (19.9%), some with medium-enriched uranium (40 to 45%), a few with high-enriched uranium (93%), and a few with depleted uranium (0.2 to 0.4%) were tested for comparison. These fuel materials were irradiated to burnups ranging from ~27 to 98 at. % ^{235}U depletion. Operation of the experiment, measurement of miniplate thickness as the irradiation progressed, ultimate shipment of the irradiated miniplates to various hot cells, and preliminary results are reported here. 18 refs., 12 figs., 7 tabs.

33543 (STUDSVIK-STSR–8) **Power ramping of the rods PW3/1, 2, 3 and 4: irradiation report: The Studsvik Super-Ramp Project.** Rumlt onnberg, G. Studsvik Energiteknik AB, Nykoeping (Sweden). Apr 1981. 30p. Sponsored by DOE Nuclear Energy. DOE Contract FG06-80ET34032. Order Number DE89013233/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; GPO Dep.

The PW3 rods were ramp tested in R2 at the beginning of March 1981. The power ramps were performed with the test conditions agreed upon at the first project committee meeting. The ramp test results are summarized in this document. 4 refs., 19 figs., 1 tab.

2204 Control Systems

33544 (SAND–88-7170C) **Predicting emergency diesel starting performance.** DeBey, T.M. Sandia National Labs., Albuquerque, NM (USA). 1989. 6p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890721–7: Joint ASME/JSME pressure vessel and piping conference, Honolulu, Hawaii, USA, 23-27 Jul 1989). Order Number DE89005210/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The US Department of Energy effort to extend the operational lives of commercial nuclear power plants has examined methods for predicting the performance of specific equipment. This effort focuses on performance prediction as a means for reducing equipment surveillance, maintenance, and outages. Realizing these goals will result in nuclear plants that are more reliable, have lower maintenance costs, and have longer lives. This paper describes a monitoring system that has been developed to predict starting performance in emergency diesels. A prototype system has been built and tested on an engine at Sandia National Laboratories. 2 refs.

33545 (SAND–89-0858) **Authentication of operator-designed monitoring systems.** Mangan, D.L.; Sonnier, C.S.; Drayer, D.D. Sandia National Labs., Albuquerque, NM (USA). Apr 1989. 38p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. Order Number DE89012881/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The IAEA is increasingly confronted with decisions on how to use operator designed monitoring systems. A major question in the use of such systems focuses on how they may be authenticated. This report identifies four major areas of concern for authentication of an operator designed system. Generic methods to address these areas of concern are presented. Suggestions are also given on design features an operator can incorporate when designing a system which will aid in the application of authentication techniques.

2205 Environmental Aspects

Refer also to citation(s) 33126, 33573, 33586, 33590, 34434, 34444, 34469, 34471, 34472, 34510

33546 (CEA-DAS–568) **Nuclear installations sites safety.** Barber, P.; Candes, P.; Duclos, P.; Doumenc, A.; Faure, J.; Hugon, J.; Mohammadioun, B. CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete. Nov 1988. 195p. (In French). (CONF-8811217–: Maroco-French cooperation in nuclear safety, Rabat, Massachusetts, USA, 28 Nov - 3 dec 1988). Order Number DE89776472/JAW. Available from NTIS (US Sales Only), PC A09/MF A01.

This report is divided into ten parts bearing: 1 Safety analysis procedures for Basis Nuclear Installations sites (BNI) in France 2 Site safety for BNI in France 3 Industrial and transport activities risks for BNI in France 4 Demographic characteristics near BNI sites in France 5 Meteorologic characteristics of BNI sites in France 6 Geological aspects near the BNI sites in France 7 Seismic studies for BNI sites in France 8 Hydrogeological aspects near BNI sites in France 9 Hydrological aspects near BNI sites in France 10 Ecological and radioecological studies of BNI sites in France.

33547 (NKS–88-7, pp. 5) **200 Radioactivity transport and the environmental effects, AKTU.** Tveten, U. (IFE (Norway)). Nordisk Kontaktorgan for Atomenergispoergsmaal, Risoe (Denmark). Nov 1988. (In Norwegian). In *Nordic projects concerning nuclear safety. Report for January-June 1988.* Order Number DE89618061/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Description of research programs concerning radioactivity transport and environmental impacts in the event of leakage from nuclear reactors. (AB).

33548 (NKS–88-7, pp. 11-13) **Management of nuclear fallout, KAV-300.** Moberg, L. (SSI (Sweden)). Nordisk Kontaktorgan for Atomenergispoergsmaal, Risoe (Denmark). Nov 1988. (In Swedish). In *Nordic projects concerning nuclear safety. Report for January-June 1988.* Order Number DE89618061/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The briefly described projects emphasize research on fallout impact, especially on its pollutive effects on underground water. (AB).

2206 Research, Test, and Experimental Reactors

Refer also to citation(s) 33246, 33542, 33543, 33583, 33593, 33596, 34124, 35186

33549 (AECL–9060) **Selecting a MAPLE research reactor core for 1-10 mW operation.** Smith, H.J.; Roy, M.-F.; Carlson, P.A. Atomic Energy of Canada Ltd., Pinawa, MB (Canada). Whiteshell Nuclear Research Establishment. Jun 1986. 11p. (CONF-860613–: 26. annual international conference of the Canadian Nuclear Association and the 7. annual conference of the Canadian Nuclear Society, Toronto, Ontario, Canada, 8-11 Jun 1986). Order Number DE89620264/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The MAPLE class of research reactors is designed so that a single reactor concept can satisfy a wide range of practical applications. This paper reports the results of physics studies performed on a number of potential core configurations fuelled with either 5 w/o or 8 w/o enriched UO_2 or 20 w/o U_3Si-Al and assesses the relative

merits of each. Recommended core designs are given to maximize the neutron fluxes available for scientific application and isotope production.

33550 (JAERI-M–88-250) **Determination of hot spot factors for calculation of the maximum fuel temperatures in the core thermal and hydraulic design of HTTR.** Maruyama, Soh; Yamashita, Kiyonobu; Fujimoto, Nozomu; Murata, Isao; Shindo, Ryuichi; Sudo, Yukio. Japan Atomic Energy Research Inst., Tokyo (Japan). Dec 1988. 92p. (In Japanese). Order Number DE89778092/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

The Japan Atomic Energy Research Institute (JAERI) has been designing the High Temperature Engineering Test Reactor (HTTR), which is 30 MW in thermal power, 950deg C in reactor outlet coolant temperature and 40 kg/cm^2 G in primary coolant pressure. This report summarizes the hot spot factors and their estimated values used in the evaluation of the maximum fuel temperature which is one of the major items in the core thermal and hydraulic design of the HTTR. The hot spot factors consist of systematic factors and random factors. They were identified and their values adopted in the thermal and hydraulic design were determined considering the features of the HTTR.

33551 (JAERI-M–88-255) **Core thermal and hydraulic design of High Temperature Engineering Test Reactor (HTTR).** Maruyama, Soh; Fujimoto, Nozomu; Yamashita, Kiyonobu; Murata, Isao; Shindo, Ryuichi; Sudo, Yukio. Japan Atomic Energy Research Inst., Tokyo (Japan). Dec 1988. 137p. (In Japanese). Order Number DE89778094/JAW. Available from NTIS (US Sales Only), PC A07/MF A01.

This report describes the outline and evaluation results of core thermal and hydraulic design of High Temperature Engineering Test Reactor (HTTR; 30 MW in thermal and 950deg C in reactor outlet coolant temperature), which is being designed at the Japan Atomic Energy Research Institute (JAERI). The HTTR core is so designed that the maximum fuel temperature may not exceed the design limit under the normal operation and the abnormal transients during operation. Therefore, the core should be designed so as to maintain the sufficient core flow rate and to keep the maximum fuel temperature as low as possible, considering the structural features of core and fuel. The maximum fuel temperature is 1495deg C in standard core of 950deg C operation at 330EFPD.

33552 (JINR–13-88-345) **Power noise spectrum classification in the problem of the IBR-2 reactor.** Bargel, M.; Kitowski, J.; Pepelyshev, Yu.N. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics. 1988. 15p. (In Russian). Order Number DE89620274/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The classification spectrum results of random fluctuations in the IBR-2 energy pulse are presented. The work is performed for the application of the obtained results to the reactor diagnostics and the study of its noise uncontrolled states. For classification of the spectra the method of pattern recognition based upon the ISODATA heuristic algorithm is used. It is shown that a set of noise uncontrolled reactor states, registered during the reactor operation period at power of 0.4-2 MVt with the first variant of moving reflector (1983-1986) is formed into 4(5) most typical states. Each of the states corresponds to the general conditions of the reactor core cooling and provides the normal work of the moving reflector. However, these states differ in coolant flow, power level and peculiarities of the moving reflector rotation regime. One type of anomal power noise, connected with some disorder in the moving reflctor work, is isolated. This work also presents the possibility of control over the state of moving reflectors according to the change in the amplitude of power oscillations at some frequences. The reactor noise classification results can be used as the data bank for the IBR-2 reactor diagnostic system. 6 refs.; 7 figs.; 6 tabs.

33553 (JINR-R–13-88-346) **Results of experimental and calculational studies of perspective reactivity modulator for the IBR-2 reactor.** Lomidze, V.L.; Rogov, A.D.; Shabalin, E.P.; Noak, K. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics. 1988. 14p. (In Russian). Order Number DE89620273/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Submitted to the journal At. Ehnerg.

The perspective heterogeneous reactivity modulator for the IBR-2 reactor made of nickel alloy permits to cut down twice the duration of neutron pulse in the IBR-2 reactor at previous limitations on moving reflector rotation velocity of 1500 rev/min. The expected value of power pulse halfwidth for fast neutrons is (115±5) mks. The results are derived by optimizational calculations using the Monte-Carlo method. It is confirmed by direct measurements of modulator parameters in the reactor. 6 refs.; 6 figs.; 4 tabs.

33554 (KEK–88-3, pp. 137-162) **Self-regulating characteristic of KUR cold neutron source.** Kawai, T. (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.); Utsuro, M.; Maeda, Y.; Ebisawa, T.; Akiyoshi, T.; Yamaoka, H.; Okamoto, S. National Lab. for High Energy Physics, Oho, Ibaraki (Japan). Jun 1988. (CONF-8803216–: 1. KEK symposium on ultra cold neutrons (UCN), Tsukuba, Japan, 10 Mar 1988). In *1st KEK symposium on ultra cold neutrons (UCN).* Order Number DE89012146/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

This report describes the Kyoto University Reactor-Cold Neutron Source (KUR-CNS) which was the first CNS operated with coupling to the reactor in Japan. Our cold neutron source is operated by a closed-indirect cooling loop. The hydrogen cryogenic system of the KUR-CNS has been shown a self-regulating characteristic to the thermal disturbances smaller than 30 % of the maximum heat load, which is measured 300 W at 25 K. This power is used to release a nuclear heating. This self-regulating characteristic was confirmed from the amplitude vs frequency curve, so called Bode's diagram, which showed the first order time lag. Due to this property, the liquid level in the moderator cell has been kept almost constant under 5 MW power of the reactor. The measurements of neutron counting rates across the central level of the moderator cell showed that the demanded liquid content was stored in the cell. From the data of TOF spectrum, the 6 A cold neutron gain was about a factor 20 using hydrogen as a moderator.

33555 (KURRI-TR–303, pp. 34-39) **Present condition and future plan of KUR-ISOL. Efficient ionization of rare-earth elements by the oxidation technique.** Kawase, Yoichi (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.); Okano, Kotoyuki. Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst. May 1988. (In Japanese). (CONF-8801127–: 4. specialist research meeting on measurements of short-lived isotopes, Kyoto, Japan, 12-13 Jan 1988). In *Proceedings of the 4th specialist research meeting on measurements of short-lived isotopes.* Order Number DE89003364/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

Some modifications have recently been made to KUR-ISOL. What is of the greatest importance is the development of an improved ion source. A new one is now planned to be constructed. In addition to the development, a study has also been made to increase the efficiency of ionization of rare-earth elements by using the conventional surface-ionization type ion source. A large increase in ionization efficiency was achieved by the technique. The present report outlines major results of this study. To increase the ionization efficiency, it is necessary to use an ionizer with a large value of phi (work function of the metal used for ionization) and to raise the temperature of the ionizer. A possible technique to increase the value of phi is to oxidize the surface of the ionizer. To determine the performance of the technique, a small amount of oxygen gas is introduced in helium gas for the helium jet, and its effect on the yield of ions is observed. Results show that the yield of ^{146}Ba is increased by about 50 percent maximum and that the change in ionization efficiency with temperature becomes smaller as the temperature is raised. The oxidation technique is also applied to quantitative determination of ^{154}Pr, and good results are obtained. (N.K.).

33556 (KURRI-TR–305, pp. 1-12) **Research on reactor physics using the Kyoto University Critical Assembly (KUCA). Recent study in the KUCA.** Shiroya, Seiji (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.). Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst. Jul 1988. (In Japanese). (CONF-8711251–: Seminar on reactor physics experiments with critical assemblies, Kyoto, Japan, 26 Nov 1987). In *Proceedings of the seminar on reactor physics experiments with critical assemblies.*

Order Number DE89003363/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

The Kyoto University Critical Assembly (KUCA) was constructed for the purpose of carrying out the basic research on the nuclear characteristics of reactors, the research for development, and education and training, and it is the research facilities used by the universities in whole Japan in common. As the initial concrete objective of use, the basic research on high neutron flux reactors, the basic research on intermediate neutron reactors, the basic research on tritium breeder reactors, the research as the extension of subcritical experiment, the education and training of the students majoring in atomic energy and so on were listed. This experimental facilities are the type with plural racks, which are rare in the world, and are composed of two solid moderator racks, on light water moderator rack and one additional accelerator. The initial criticality was attained in 1974. The critical assembly special research group has played extremely large role in the research on reactor physics. The research on reactor physics at KUCA, for example tritium breeder reactors and tight lattice reactors, the research on criticality safety and so on are reported. (K.I.).

33557 (KURRI-TR–305, pp. 13-20) **Research on reactor physics using the fast critical facility FCA.** Nakano, Masafumi (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst. Jul 1988. (In Japanese). (CONF-8711251–: Seminar on reactor physics experiments with critical assemblies, Kyoto, Japan, 26 Nov 1987). In *Proceedings of the seminar on reactor physics experiments with critical assemblies.* Order Number DE89003363/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

In the Fast Critical Assembly (FCA), the initial criticality was attained in April, 1967, by charging 20 % enriched uranium fuel, since then, 15 types of the core by rough classification were assembled during more than 20 years, and the various experiments on reactor physics have been carried out. The outline of criticality experiment at the FCA is shown. During initial several years, by using a small core in which 20 % enriched uranium was charged, the development of measuring techniques in a fast neutron spectrum field and the evaluation of cross section by integral experiment were carried out. After plutonium fuel was obtained in 1970, the mock-up experiment of the experimental FBR 'Joyo' and the prototype FBR 'Monju' has been mainly carried out. The physical mock-up experiment by paying attention to the composition characteristics and the engineering mock-up experiment including the form characteristics were carried out to obtain the data contributing to the design and safety evaluation. FCA standard spectrum core experiment, large axially heterogeneous core experiment, tight lattice core experiment, and the research on safety, new type fuel fast reactors and combustion core characteristics hereafter are reported. (K.I.).

33558 (KURRI-TR–305, pp. 21-35) **Research on reactor physics using the Tank-type Critical Assembly (TCA). Focusing on the method for reactivity determination based on buckling measurements.** Suzaki, Takenori (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst. Jul 1988. (In Japanese). (CONF-8711251–: Seminar on reactor physics experiments with critical assemblies, Kyoto, Japan, 26 Nov 1987). In *Proceedings of the seminar on reactor physics experiments with critical assemblies.* Order Number DE89003363/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

The TCA is a critical assembly with light water moderation and light water reflection, which uses low enriched UO_2 or low enriched MOX fuel rods. Since the attainment of the initial criticality in August, 1962, to November, 1987, the operation has been carried out about 8,000 times. The themes of the TCA experiment are shown, and they are roughly classified into the themes related to LWR design and those related to the criticality safety in other nuclear fuel facilities than nuclear reactors. In the former, the various subjects accompanying the development of LWRs in Japan were experimented, and the understanding of LWR physics has been deepened. Around 1980, the nuclear fuel cycle technology in Japan advanced, and the importance of evaluating the criticality safety in the related facilities has heightened. The themes in the latter were begun, based on the circumstance like this, and the TCA experiment using rod type fuel has been carried out. The design of a new criticality experiment facility using nitric acid aqueous solution fuel is in progress. Buckling change and reactivity, application to a critical system and subcritical system and so on are reported. (K.I.).

33559 (KURRI-TR–305, pp. 36-44) **Research on reactor physics using the Japan Materials Testing Reactor Critical Facility (JMTRC). Recent studies in the JMTRC.** Shimakawa, Satoshi (Japan Atomic Energy Research Inst., Oarai, Ibaraki. Oarai Research Establishment). Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst. Jul 1988. (In Japanese). (CONF-8711251–: Seminar on reactor physics experiments with critical assemblies, Kyoto, Japan, 26 Nov 1987). In *Proceedings of the seminar on reactor physics experiments with critical assemblies.* Order Number DE89003363/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

The JMTRC of 100 W was installed for the purpose of carrying out the basic experiment on the nuclear characteristics of reactors and the preceding test related to the operation plan of the Japan material testing reactor (JMTR, 50 MW). After the attainment of the initial criticality in October, 1965, for obtaining the reactor physics characteristics, criticality experiment was begun. The items of the criticality experiment were critical mass, control rod worth, reactor dynamic characteristic parameters, shutdown margin and so on, and these experimental data were effectively utilized for the safety evaluation in the operation of the JMTR. The preceding test using the JMTRC has been carried out for obtaining the nuclear characteristics of samples and the thermal characteristics estimated from those results by simulating the JMTR core. In August, 1983, the degree of fuel enrichment for the JMTRC was reduced to 45 % U-235, and various experiments usig the MEU core were carried out. In this paper, the criticality experiment using the MEU core and the experiment on the characteristics of lithium-containing pellets are reported. (K.I.).

33560 (ORNL/TM–11187) **Oak Ridge Research Reactor shutdown maintenance and surveillance quarterly report January, February, and March 1989.** Coleman, G.H.; Laughlin, D.L. Oak Ridge National Lab., TN (USA). May 1989. 16p. Sponsored by DOE Nuclear Energy. DOE Contract AC05-84OR21400. Order Number DE89012818/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The ORR was not operated during January, February, and March of 1989. Maintenance activities, both mechanical and instrument, were essentially routine in nature. Details of fuel usage and inventory are provided in this document. Reactor downtime (power level $<N_L$) totaled 2160 hours. A summary of the shutdown and details of the scheduled shutdown are provided. The performance of the instrumentation for the facility was satisfactory, and maintenance activity are discussed. The performance of the process system was satisfactory, and experiment facility usage is given.

2207 Plutonium and Isotope Production Reactors

Refer also to citation(s) 33571, 33595

33561 (WHC-EP–0259) **Production Test N-611 and N-614 emergency cooling/fog spray supply characterization tests: Final report.** Conn, K.R.; Kelly, W.S.; Zaloudek, F.R. Westinghouse Hanford Co., Richland, WA (USA). May 1989. 76p. Sponsored by DOE Nuclear Energy. DOE Contract AC06-87RL10930. Order Number DE89013167/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

The results of Production Tests N-611 and N-614 (PTN-611 and PTN-614), Emergency Cooling/Fog Spray Supply Characterization Tests are reported. These production tests consisted of 21 individual tests designed to characterize the diesel-driven pumps and piping sections in the emergency core cooling system (ECCS), the fog spray systems, and the effluent disposal systems. Production Test N-614 included demineralized water and filtered water tank drawdowns and emergency raw water tank fillups to calibrate flow measurement devices in the RWS-2 and the ECCS, and tests to establish the performance of the high-lift fog spray diesel-driven pumps. It also demonstrated operation of the low-lift diesel-driven

pumps with the river flow at the minimum release rate allowed by the operating license for Priest Rapids Dam. The tank drawdown data was also used to determine loss coefficients in piping between the demineralized water storage tank and the high-lift diesel-driven pumps. Other tests provided information on the division of the low lift flow between the silo and the RWS-2, and on the performance of the low-lift diesel-driven pumps. 13 figs., 7 tabs.

33562 Applications of molten salts in plutonium processing. Bowersox, D.F. (Los Alamos National Lab., Los Alamos, NM (US)); Christensen, D.C.; Williams, J.D. v.v of Proceedings of the Electrochemical Society Fall meeting: Extended abstracts. Volume 87-2. The Electrochemical Society, Pennington, NJ (1987). (CONF-871027–: 172. meeting of the Electrochemical Society, Honolulu, Hawaii, USA, 18-23 Oct 1987).

Pyrochemical processes are defined as nonaqueous operations conducted at elevated temperatures. Records indicate that crude methods for producing some metals existed as early as 3000 BC. Pyrometallurgy is still employed to make iron, copper, zinc and nickel; however, the modern application most similar to the plutonium process is that used to produce aluminum. In this report, the four major steps in processing plutonium are described. Salts and eutectics in use and promising alternatives are discussed.

33563 Status of plutonium purification by bismuth solvent anode electrorefining. Fife, K.W. (Plutonium Metal Technology Group, Div. of Materials Science and Technology, Los Alamos National Lab., Los Alamos, NM (US)); Bowersox, D.F.; McCurry, L.E.; Lopez, P.C.; Brown, C. v.v of Proceedings of the Electrochemical Society Fall meeting: Extended abstracts. Volume 87-2. The Electrochemical Society, Pennington, NJ (1987). (CONF-871027–: 172. meeting of the Electrochemical Society, Honolulu, Hawaii, USA, 18-23 Oct 1987).

Impure plutonium metal is currently purified at Los Alamos by molten salt electrorefining. The procedure involves oxidation from an impure molten plutonium anode, transport through an equimolar NaCl-KCl electrolyte, and reduction at a tungsten cathode. Overall plutonium recovery from the process ranges between 70% and 75%, considering all types of process feed. The technique is effective for producing pure plutonium metal (> 99.95%). Overall plutonium recoveries, however, are directly related to the purity of the feed material. High-purity feed exhibits high oxidation and reduction efficiencies resulting in high overall recovery. With impure feed, high-melting plutonium alloys tend to form as plutonium is depleted from the anode and the impurities concentrate. The formation of these high-melting alloys reduces plutonium oxidation and diffusion rates, prohibits good mixing in the anode compartment, and effectively terminates the run leaving significant quantities of plutonium in the spent anode. To reprocess this rich residue, a variation of molten salt electrorefining is being developed. Solvent mode electrorefining incorporates a secondary-metal solvent added to the plutonium in sufficient concentrations to keep the resulting mixture liquid throughout all anticipated plutonium concentration ranges. With the anode remaining liquid throughout the process, the opportunity for increased oxidation efficiencies and, therefore, increased overall recoveries is possible from electrorefining.

33564 Isotope production at Department of Energy sites in the United States of America. Ratledge, J.E. (Oak Ridge National Laboratory, TN (USA)). *Transactions of the American Nuclear Society (USA),* 56(1): 365-372 (1988). (CONF-870905–: 6. Pacific Basin nuclear conference, Beijing, China, 7-11 Sep 1987).

The United States Department of Energy (USDOE) provides both stable and radioactive isotopic materials and services required for many domestic and foreign research, development, and/or Commercial applications. The materials and services are available through the Isotope Distribution Program established by the USDOE at the Oak Ridge National Laboratory (ORNL), which is operated by Martin Marietta Energy Systems, Inc. The materials and services are provided on a full-cost recovery basis and are limited to those materials and services that are not commercially available. The stable and radioisotope production and/or processing capabilities at various USDOE sites and the availability of the materials and services through the ORNL Isotope Distribution Program are described in detail.

2208 Propulsion Reactors

33565 (CONF-890103–10) **Use of cermet fueled nuclear reactors for direct nuclear propulsion.** Bhattacharyya, S.K.; Carlson, L.W.; Kuczen, K.D.; Hanan, N.A.; Palmer, R.G.; Von Hoomissen, J.; Chiu, W.; Haaland, R. Argonne National Lab., IL (USA). Jul 1988. 5p. Sponsored by DOE Nuclear Energy. DOE Contract W-31109-ENG-38. From 6. symposium on space nuclear power systems; Albuquerque, New Mexico, USA; 9-12 Jan 1989. Order Number DE89013192/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

There has been a renewal of interest in Direct Nuclear Propulsion (DNP) because of the Air Force Forecast II recommendation for the development of the technology. Several nuclear concepts have been proposed to meet the Direct Nuclear Propulsion challenge. In this paper we will present results of an initial study of the potential of a cermet fueled nuclear system in providing the desired DNP capabilities and featuring a set of unique safety characteristics. The concept of cermet fuel for DNP applications was first developed by ANL and GE working independently more than 20 years ago. The two organizations came to several remarkably consistent conclusions. The present work has consisted of collecting a unified set of design parameters from the set of design results produced in the earlier work. The conclusion of this exercise was that a cermet-fueled DNP design looked extremely promising from performance and safety considerations and that it deserves serious consideration when the decision to develop one or more concepts for DNP is made.

2209 Reactor Safety

Refer also to citation(s) 33481, 33525, 33527, 33548, 33561, 33868, 33893, 33894, 33895, 33896, 33897, 33898, 33899, 34203, 34450, 34451, 34452, 34453, 34454, 34469, 34510, 34729, 34730, 34731, 34732, 34733, 34734, 34735, 34736, 34737, 34738, 34739, 34740, 34741, 34742, 34743, 34744, 34745, 34746, 34747, 34748, 34749, 34750, 34751, 34752, 34753, 35197

33566 (BNL-NUREG–42704) **Seismic capacity of switchgear.** Bandyopadhyay, K.; Hofmayer, C.; Kassir, M.; Pepper, S. Brookhaven National Lab., Upton, NY (USA). 1989. 7p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC02-76CH00016. (CONF-890721–33: Joint ASME/JSME pressure vessel and piping conference, Honolulu, Hawaii, USA, 23-27 Jul 1989). Order Number DE89013223/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

As part of a component fragility program sponsored by the USNRC, BNL has collected existing information on the seismic capacity of switchgear assemblies from major manufacturers. Existing seismic test data for both low and medium voltage switchgear assemblies have been evaluated and the generic results are presented in this paper. The failure modes are identified and the corresponding generic lower bound capacity levels are established. The test response spectra have been used as a measure of the test vibration input. The results indicate that relays chatter at a very low input level at the base of the switchgear cabinet. This change of state of devices including relays have been observed. Breaker tripping occurs at a higher vibration level. Although the structural failure of internal elements have been noticed, the overall switchgear cabinet structure withstands a high vibration level. 5 refs., 2 figs., 2 tabs.

33567 (BNL-NUREG–42722) **Alternate modal combination methods in response spectrum analysis.** Wang, Y.K.; Bezler, P. Brookhaven National Lab., Upton, NY (USA). 1989. 10p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC02-76CH00016. (CONF-890721–34: Joint ASME/JSME pressure vessel and piping conference, Honolulu, Hawaii, USA, 23-27 Jul 1989). Order Number DE89012666/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

In piping analyses using the response spectrum method Square Root of the Sum of the Squares (SRSS) with clustering between closely spaced modes is the combination procedure most commonly used to combine between the modal response components. This procedure is simple to apply and normally yields conservative estimates of the time history results. The purpose of this study is to

investigate alternate methods to combine between the modal response components. These methods are mathematically based to properly account for the combination between rigid and flexible modal responses as well as closely spaced modes. The methods are those advanced by Gupta, Hadjian and Lindley-Yow to address rigid response modes and the Double Sum Combination (DSC) method and the Complete Quadratic Combination (CQC) method to account for closely spaced modes. A direct comparison between these methods as well as the SRSS procedure is made by using them to predict the response of six piping systems. For two piping systems thirty-three earthquake records were considered to account for the impact of variations in the characteristics of the excitation. The results provided by each method are compared to the corresponding time history estimates of results as well as to each other. The degree of conservatism associated with each method is characterized. 7 refs., 4 figs., 2 tabs.

33568 (CEA-DAS–533e) **Evolution of general design requirements for french pressurized water reactors.** Gros, G.; Jalouneix, J.; Rollinger, F. CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete. Oct 1988. 11p. (CONF-881014–: International European Nuclear Society/American Nuclear Society meeting on thermal reactor safety, Avignon, France, 2-7 Oct 1988). Order Number DE89781556/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The design of French pressurized water reactors is based first on deterministic principles, using the well-known defense in depth concept. This safety approach, basically reflected current American practice at that time, which consisted notably in designing engineered safeguard systems capable of limiting the consequences of accidents assumed to be credible despite the preventive measures taken. Further reflections have led to complete this approach, resulting in modifications to regulatory practice, mainly related to better practical assimilation of the problems arising during plant unit operation and reactor control after an accident and to the determination to enhance the overall consistency of the safety approach. As regards system redundancy, it should be noted that common cause failures can result in the total loss of a redundant system. System redundancy aspects will be dealt with in Chapter 2. As regards study of design basis accidents, attention was focused on the human intervention stage following automatic activation of protection and safeguard systems. This resulted, for all plant units, in the revision of operating procedures, accompanied by examination of the means required for their implementation. These subjects will be discussed in Chapter 3. Finally, as regards equipment classification, the range of equipment subjected to particular requirements, formerly limited to design basis safety classified equipment, was enlarged to include important for safety equipment. This subject will be dealt with in Chapter 5.

33569 (CONF-890782–1) **Design and operation of the communication alarm processor expert system.** Purucker, S.L.; Tonn, B.E.; Goeltz, R.T.; Wiggen, T.P.; Hemmelman, K.M.; Borys, S.F.; Rasmussen, R.D. Oak Ridge National Lab., TN (USA). 1989. 7p. Sponsored by DOE Environment Health & Safety. DOE Contract AC05-84OR21400. From 2. symposium on expert systems application to power systems; Seattle, Washington, USA; 17-20 Jul 1989. Order Number DE89012507/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This paper discusses the expert system design, verification testing, installation, and initial operating experiences of the Communications Alarm Processor (CAP), a prototype expert system developed for Bonneville Power Administration (BPA) by Oak Ridge National Laboratory. The system is designed to assist operators by receiving and diagnosing alarms from Bonneville's Microwave Communications System. The microwave system transmits data from power facilities in four Pacific Northwestern states to Dittmer, Bonneville's central operations control center. The prototype is limited to one of seven branches of the communications network and a subset of alarm systems and alarm types. CAP receives real-time data, diagnoses operational problems, archives alarm information, and supports analysis aimed at improving equipment maintenance. The expert system operates in an advisory capacity so diagnoses are presented to operators for their review and concurrence before being archived. CAP employs a backward chaining approach for diagnosing alarms. The system, which was delivered in January 1989, resides on a VAX 3200 workstation under the VMS operating system and utilizes C code to retrieve and process alarm data. An expert system shell, Nexpert Object, was used to develop the expert system. The ultimate goal is to develop expert systems that will enhance power system operation and maintenance. 7 refs., 8 figs., 1 tab.

33570 (GRS–68) **Operating experience and reactor safety.** Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Garching (Germany, F.R.). Mar 1988. 117p. (In German). (CONF-8710356–: GRS experts' discussion on operations experiences and reactor safety, Muenchen, Germany, F.R., 29-30 Oct 1987). Available from Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Garching (Germany, F.R.).

Records of all papers of the special meeting were published at the same time in 'Technische Mitteilungen' no. 1 (1988) by Vulkan-Verlag and are already in the database.

33571 (HW–33452) **Consequences of loss of cooling water to a single process tube.** Ekern, W.F. General Electric Co., Richland, WA (USA). Hanford Atomic Products Operation. 18 Oct 1954. 12p. Sponsored by DOE Defense Programs. DOE Contract AC06-76RL01830. Order Number DE89013136/JAW. Available from NTIS, PC A03/MF A01 - OSTI.

Declassified 1 Jun 1989.

Time sequence information regarding the events which follow loss of process cooling water in a HAPO pile is a necessary goal of the reactor hazard study program which is currently being made by the Pile Engineering Unit. It is from such information that the scope of possible consequences of a process water loss might be obtained and that the necessity for and feasibility of certain preventive measures might be evaluated. This report considers the events which occur in a single process tube following an instantaneous loss of process water to the tube. Loss of water is assumed to be caused by some severe condition such as complete rupture of an inlet pigtail. 5 refs., 1 fig., 6 tabs.

33572 (IAEA-TECDOC–480) **Improving operational safety management through probabilistic safety assessment on personal computers. Report of a technical committee meeting held in Vienna, 16-20 March 1987.** International Atomic Energy Agency, Vienna (Austria). Oct 1988. 138p. (CONF-8703320–: Technical committee meeting on the use of probabilistic safety assessment on personal computers for operational safety management, Vienna, Austria, 16-20 Mar 1987). Order Number DE89617155/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

The Technical Committee Meeting considered the current effort in the implementation and use of PSA information for day-to-day operational safety management on Personal Computers. Due to the very recent development of the necessary hardware and software for Personal Computers, the application of PSA information for day-to-day operational safety management on PCs is essentially still in a pioneering stage. There is at present only one such system for end users existing, the PRISIM (Plant Risk Status Information Management) program for which a limited practical application experience is available. Others are still in the development stage. The main aim of the Technical Committee Meeting was to discuss the present status of PSA based systems for operational safety management support on small computers, to consider practical aspects when implementing these systems into a nuclear installation and to address problems related to the further work in the area. A separate abstract was prepared for the summary of the Technical Committee Meeting and for the 8 papers presented by the participants. Refs, figs and tabs.

33573 (INIS-mf–11456, pp. 27-34) **Nuclear energy and environment.** Povinec, P. (Komenskeho Univ., Bratislava (Czechoslovakia). Matematicko-Fyzikalna Fakulta). Jednota Ceskoslovenskych Matematiku a Fyziku, Prague (Czechoslovakia). 1987. (In Slovak). (CONF-8707217–: 9. conference of Czechoslovak physicists, Pardubice, Czechoslovakia, 6-10 Jul 1987). In *Ninth conference of Czechoslovak physicists. Part 1, 2.* Order Number DE89617602/JAW. Available from NTIS (US Sales Only), PC A22/MF A01 - OSTI; INIS.

A comparison is made of the environmental impact of conventional and nuclear power plants in normal operation. Presented and compared are the activities of fission products released during the accidents at Windscale, Three Mile Island and Chernobyl. The concentrations are given of fission products in some foodstuffs in Czechoslovakia following the Chernobyl accident and a comparison is made with values measured in the period of nuclear weapon testing. An estimate is made of man's exposure to external irradiation. (J.B.). 6 figs., 5 tabs., 13 refs.

33574 (INIS-mf–11982, pp. 39.1) **Thermal shock test PST-1 - results and theoretical analysis.** Milella, P. (ENEA, Rome (Italy)); Pini, A.; Vitale, E. Staatliche Materialpruefungsanstalt, Stuttgart (Germany, F.R.). 1987. (CONF-8710410–: 13. MPA seminar on safety and reliability of pressure components: the contribution of component and large specimen testing to structural integrity assessment methodology, Stuttgart, Germany, F.R., 8-9 Oct 1987). In *Safety and reliability of pressure components with special emphasis on the contribution of component and large specimen testing to structural integrity assessment methodology. Vol. 2. Pipe failure, components, thermal shock loading, high temperature behaviour, integrity of vessels, integrity of welded joints.* Order Number DE89783126/JAW. Available from NTIS (US Sales Only), PC A99/MF A01.

PRESSURE VESSELS/thermal shock; REACTOR SAFETY EXPERIMENTS; BWR TYPE REACTORS; PWR TYPE REACTORS; PLATES; CYLINDERS; COMPUTER CALCULATIONS

33575 (INIS-mf–11982, pp. 29.1-29.22) **Fracture behaviour of pipes loaded by internal pressure and external bending moments.** Stoppler, W. (Stuttgart Univ. (Germany, F.R.). Staatliche Materialpruefungsanstalt); Schiedermaier, J.; Hippelein, K.; Sturm, D.; Shen, S. Staatliche Materialpruefungsanstalt, Stuttgart (Germany, F.R.). 1987. (In German). (CONF-8710410–: 13. MPA seminar on safety and reliability of pressure components: the contribution of component and large specimen testing to structural integrity assessment methodology, Stuttgart, Germany, F.R., 8-9 Oct 1987). In *Safety and reliability of pressure components with special emphasis on the contribution of component and large specimen testing to structural integrity assessment methodology. Vol. 2. Pipe failure, components, thermal shock loading, high temperature behaviour, integrity of vessels, integrity of welded joints.* Order Number DE89783126/JAW. Available from NTIS (US Sales Only), PC A99/MF A01.

Investigations within the scope of phase II of the scientific research project 'vessel failure', served to verify whether conditions analogous to those derived for pipes with longitudinal flaws also exist for pipes having circumferential faults. In particular, proof is to be supplied that before piping made of a deformable material (high notched-bar impact work plateau values) with tolerable circumferential defects breaks, bending moments can be applied that cause a large-scale plastic deformation of the pipe wall. These investigations are intended to test meeting of the requirements that kinetic energy, which may be induced in the system by earthquakes, water-shock or aircraft-crashes, may be relaxed by plastic deformation of the (flawed) pipe. In the case of shock (or periodically)-induced oscillations, the allowance of plastification implies large damping factors.

33576 (INIS-mf–11982, pp. 31.1-31.32) **Assessment of large scale pipe tests by fracture mechanics approximation procedures with regard to leak-before-break.** Roos, E. (Stuttgart Univ. (Germany, F.R.). Staatliche Materialpruefungsanstalt); Herter, K.H.; Julisch, P.; Bartholome, G.; Senski, G. Staatliche Materialpruefungsanstalt, Stuttgart (Germany, F.R.); Kraftwerk Union A.G., Erlangen (Germany, F.R.). 1987. (In German). (CONF-8710410–: 13. MPA seminar on safety and reliability of pressure components: the contribution of component and large specimen testing to structural integrity assessment methodology, Stuttgart, Germany, F.R., 8-9 Oct 1987). In *Safety and reliability of pressure components with special emphasis on the contribution of component and large specimen testing to structural integrity assessment methodology. Vol. 2. Pipe failure, components, thermal shock loading, high temperature behaviour, integrity of vessels, integrity of welded joints.* Order Number DE89783126/JAW. Available from NTIS (US Sales Only), PC A99/MF A01.

Todays common methods of calculating the failure stress of circumferentially-flowed piping are assessed in comparison with experimental results. This includes the various limit-stress concepts and the two-criterion method. Furthermore, the leak-before-break behaviour, derived from these - and other - methods is considered.

33577 (INIS-mf–11982, pp. 32.1-32.28) **Failure behaviour of a piping system with a circumferentially orientated flaw. Analytical and experimental investigations.** Mikkola, T.P.J. (Valtion Teknillinen Tutkimuskeskus, Helsinki (Finland)); Diem, H.; Blind, D.; Hunger, H. Staatliche Materialpruefungsanstalt, Stuttgart (Germany, F.R.); Valtion Teknillinen Tutkimuskeskus, Helsinki (Finland); Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projektbereich Heissdampfreaktor - Sicherheitsprogramm. 1987. (In German). (CONF-8710410–: 13. MPA seminar on safety and reliability of pressure components: the contribution of component and large specimen testing to structural integrity assessment methodology, Stuttgart, Germany, F.R., 8-9 Oct 1987). In *Safety and reliability of pressure components with special emphasis on the contribution of component and large specimen testing to structural integrity assessment methodology. Vol. 2. Pipe failure, components, thermal shock loading, high temperature behaviour, integrity of vessels, integrity of welded joints.* Order Number DE89783126/JAW. Available from NTIS (US Sales Only), PC A99/MF A01.

The experiments were conducted on the recently installed feedwater line of the HDR reactor in Kahl. The investigations were focused on analysing both the crack propagation of a circumferentially flowed pipe under the influence of corrosion and cyclic load, together with the pipeline's subsequent failure behaviour. The experimental conditions were selected in a manner representing those which can, for example, prevail during start-up or shut-down of reactor. To this aim, the pipes were internally stressed with high pressure and temperature oxygenic water in conjunction with an externally applied bending moment. The investigations are supplemented by elastic-plastic triaxial finite element (FE) calculations for various assumed crack configurations, both prior to and following the experiments, thus granting a fracture-mechanical assessment of the structural behaviour.

33578 (INIS-mf–11982, pp. 33.1-33.28) **Calculational models for a cracked pipe elbow in a feedwater line.** Sauter, A. (Stuttgart Univ. (Germany, F.R.). Staatliche Materialpruefungsanstalt); Turan, K.; Kerkhof, K.; Wagemann, G. Staatliche Materialpruefungsanstalt, Stuttgart (Germany, F.R.). 1987. (In German). (CONF-8710410–: 13. MPA seminar on safety and reliability of pressure components: the contribution of component and large specimen testing to structural integrity assessment methodology, Stuttgart, Germany, F.R., 8-9 Oct 1987). In *Safety and reliability of pressure components with special emphasis on the contribution of component and large specimen testing to structural integrity assessment methodology. Vol. 2. Pipe failure, components, thermal shock loading, high temperature behaviour, integrity of vessels, integrity of welded joints.* Order Number DE89783126/JAW. Available from NTIS (US Sales Only), PC A99/MF A01.

The Line-Spring method for the fracture-mechanical analysis of a confined, longitudinal crack in the internal surface of a pipe elbow was tested and verified in the feedwater line of the experimental HDR reactor. The exemplary application of the elastic-plastic Line-Spring elements to an external surface flow on the intrados of a pipe elbow also delivered reliable results. When implementing into the finite element computer program ABAQUS, the Line-Spring algorithm presents an extremely efficient means of determining the elastic-plastic J-integral values of surface faults in three-dimensional structures subjected to predominant intrados crack-opening loads. With the linear elastic approach, all crack-opening modes can be derived and quantified in terms of fracture mechanics.

33579 (INIS-mf–11982, pp. 38.1-38.29) **Some current issues in the PTS research.** Jovanovic, A. (Stuttgart Univ. (Germany, F.R.). Staatliche Materialpruefungsanstalt); Sauter, A.; Lucia, A.C. Staatliche Materialpruefungsanstalt, Stuttgart (Germany, F.R.); Commission of the European Communities, Ispra (Italy). Joint Research Centre. 1987. (CONF-8710410–: 13. MPA seminar on safety and reliability of pressure components: the contribution of component and large specimen testing to structural integrity assessment methodology, Stuttgart, Germany, F.R., 8-9 Oct 1987). In *Safety*

and reliability of pressure components with special emphasis on the contribution of component and large specimen testing to structural integrity assessment methodology. Vol. 2. Pipe failure, components, thermal shock loading, high temperature behaviour, integrity of vessels, integrity of welded joints. Order Number DE89783126/JAW. Available from NTIS (US Sales Only), PC A99/MF A01.

Some current issues of particular interest in the pressurised thermal shock (PTS) research have been tackled and reviewed in the paper (with no pretention to be exhaustive or to claim that chosen issues are the most important ones). The issues regard application of damage mechanics, fracture mechanics and artificial intelligence (including the treatment of uncertainties in the PTS analysis and experiments). They have in common importance for further understanding of crack behaviour and of component and system response in PTS conditions. The sample cases are taken from the research programmes of MPA - Materialpruefungsanstalt Stuttgart, Germany, and of the JRC - Joint Research Centre.

33580 (INIS-mf–11982, pp. 45.1-45.21) **Verification of the analysis for fracture behaviour estimation of pressure vessels.** Rintamaa, R. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)); Toerroenen, K.; Talja, H.; Saarenheimo, A.; Ikonen, K. Staatliche Materialpruefungsanstalt, Stuttgart (Germany, F.R.); Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). 1987. (CONF-8710410–: 13. MPA seminar on safety and reliability of pressure components: the contribution of component and large specimen testing to structural integrity assessment methodology, Stuttgart, Germany, F.R., 8-9 Oct 1987). In *Safety and reliability of pressure components with special emphasis on the contribution of component and large specimen testing to structural integrity assessment methodology. Vol. 2. Pipe failure, components, thermal shock loading, high temperature behaviour, integrity of vessels, integrity of welded joints.* Order Number DE89783126/JAW. Available from NTIS (US Sales Only), PC A99/MF A01.

Within the Nordic countries a four-year research programme in the area of elastic-plastic fracture mechanics was initiated in 1985. According to experimental findings and both analytical and preliminary numerical results the following conlusions can be drawn: Local material degradation in the long flaw ligament did not seem to lower remarkably the structural integrity of the pressure vessel against the catastrophic failure. Rupture pressure predictions by all analytical methods used for the precalculation varied in a wide range but on the average agreed reasonably well with the experimental findings. Two dimensional finite element calculations seem to give too conservative estimations for crack opening behaviour in this particular case. Best agreement can be achieved by applying 3D FE-analysis.

33581 (INIS-mf–11982, pp. 47.1-47.21) **Assessment of a pressure vessel of the material X20CrMoV 12 1 by fracture mechanics.** Roos, E. (Stuttgart Univ. (Germany, F.R.). Staatliche Materialpruefungsanstalt); Blind, D.; Deimel, P. Staatliche Materialpruefungsanstalt, Stuttgart (Germany, F.R.). 1987. (In German). (CONF-8710410–: 13. MPA seminar on safety and reliability of pressure components: the contribution of component and large specimen testing to structural integrity assessment methodology, Stuttgart, Germany, F.R., 8-9 Oct 1987). In *Safety and reliability of pressure components with special emphasis on the contribution of component and large specimen testing to structural integrity assessment methodology. Vol.. Pipe failure, components, thermal shock loading, high temperature behaviour, integrity of vessels, integrity of welded join.* Order Number DE89783126/JAW. Available from NTIS (US Sales Only), PC A99/MF A01.

A cylindrical X20CrMoV 12 1 pressure vessel possessing a welded longitudinal and circumferential seam of the same composition as the base metal was loaded by a pulsating internal pressure. This generated two longitudinal fatigue cracks at respective crack initiation notches. One was along the longitudinal seam, the other was chiefly within the base material and partly in the circumferential weld. The latter locally penetrated the vessel wall, hence leading to leakage. With the aid of fracture-mechanical calculations, the critical crack depth, the respective number of stress cycles and the crack propagation could be calculated within safe limits.

33582 (INIS-XN–183) **NEA international co-operative projects.** Nuclear Energy Agency, 75 - Paris (France). 1989. 38p. Order Number DE89618193/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

This text is consecrated at the international co-operative projects of the OECD Nuclear Energy Agency (NEA) in the field of reactor safety (Halden reactor project, Loft project, studies on the damaged Three Mile Island unit-2 reactor, inspection of reactor steel components, incident reporting system) and in the field of radioactive waste management (Stripa project, geochemical data bases, Alligator river project, seabed disposal of high-level radioactive waste, decommissioning of nuclear facilities).

33583 (JAERI-M–88-256) **Fission product release inventory analysis code for high-temperature gas-cooled reactor during accident 'HTCORE'.** Mikami, Hisashi; Suzuki, Katsuo; Hirano, Mitsumasa; Mitake, Susumu. Japan Atomic Energy Research Inst., Tokyo (Japan). Dec 1988. 51p. (In Japanese). Order Number DE89778095/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

This code analyzes fission product release inventory from core according to the transient of core temperature at the accident as an input data and considering failure rate of coated fuel particles, fission product release rate from a coated fuel particle, a fuel compact and a graphite sleeve and radioactive decay of fission product. This code uses a basic library of 50 fission products decay chains and 149 nuclides, which include the important nuclides for safety analysis. The basic library also contains constants of fission products like decay constants and branching ratio, release rate from a coated fuel particle, diffusion coefficient in graphite, etc. This code is used for analysis of additional fission product release inventory from core according to transient of core temperature at the depressurization accident of High Temperature engineering Test Reactor (HTTR).

33584 (KURRI-TR–305, pp. 47-55) **Research on reactor physics using Deuterium Critical Assembly. Study on coolant void reactivity by substitution method.** Kowata, Yasuki (Power Reactor and Nuclear Fuel Development Corp., Oarai, Ibaraki (Japan). Oarai Engineering Center). Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst. Jul 1988. (In Japanese). (CONF-8711251–: Seminar on reactor physics experiments with critical assemblies, Kyoto, Japan, 26 Nov 1987). In *Proceedings of the seminar on reactor physics experiments with critical assemblies.* Order Number DE89003363/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

Since the Chernobyl-4 accident, the importance of void reactivity has heightened. The Chernobyl-4 accident was reactivity accident due to the rabid increase of void ratio in the coolant, accordingly the evaluation of the safety peculiar to nuclear reactors and the behavior at the time of severe accidents has become to be carried out. In particular, it is the present state that in the pressure tube type reactors using coolant and moderator separately, attention is paid to the nuclear safety. In boiling light water-cooled pressure tube type heavy water reactor ATR, the coolant void reactivity when the void ratio in coolant increased or loss of coolant accidents occurred can become positive or negative according to such lattice condition as fuel composition, because the state of moderator does not change. Therefore, to suppress void reactivity as far as possible has become an important subject for improving the operation control and nuclear safety of reactors. Among the reactor physics research using the DCA, the knowledge obtained by the measurement of coolant void reactivity in an ATR lattice using substitution method and its analysis is reported. The role of coolant void reactivity in criticality experiment, the experiment and its results are described. It was found that by the present method, the reactor physics information peculiar to a test lattice can be extracted with a small number of test fuel. (K.I.).

33585 (NKS–88-7) **Nordic projects concerning nuclear safety. Report for January-June 1988.** Soerensen, H.C. (ed.). Nordisk Kontaktorgan for Atomenergispoergsmaal, Risoe (Denmark). Nov 1988. 26p. (In Danish, Swedish, Norwegian Order Number DE89618061/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The report describes the nature of the work done in the first half of 1988 within the field of nuclear safety (1985-89) under the Nordic program for 1985-89. Five programmes and their documentation, are described and complete lists of addresses and of persons involved is given. (AB).

33586 (NKS–88-7, pp. 14-17) **Risk analysis and protection philosophy, RAS-400.** Liwaang, B. (SKI (Sweden)). Nordisk Kontaktorgan for Atomenergispoergsmaal, Risoe (Denmark). Nov 1988. (In Swedish). In *Nordic projects concerning nuclear safety. Report for January-June 1988.* Order Number DE89618061/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Description of research projects handling risks from radioactive effluents, optimization of security measures, monitoring of dose effects, and a discussion of the principles of radiation protection. (AB) 25 refs.

33587 (NKS–88-7, pp. 22-24) **Advanced information technology, INF-600.** Andersen, V. (Risoe (Denmark)). Nordisk Kontaktorgan for Atomenergispoergsmaal, Risoe (Denmark). Nov 1988. (In Danish). In *Nordic projects concerning nuclear safety. Report for January-June 1988.* Order Number DE89618061/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A very brief description of the papers on advanced information technology, in relation to accident and emergency management in the case of reactor accidents, published during the first half of 1988. Four "work packages" concerned with the situation analysis of possible nuclear catastrophes, and plans of action, are also shortly described. (AB).

33588 (NUREG–1174) **Evaluation of systems interactions in nuclear power plants: Technical findings related to Unresolved Safety Issue A-17.** Thatcher, D. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Safety Issue Resolution. May 1989. 39p. Sponsored by Nuclear Regulatory Commission. Available from NTIS, PC A03/MF A01 - GPO - OSTI.

This report presents a summary of the activities related to Unresolved Safety Issue (USI)A-17, "Systems Interactions in Nuclear Power Plants," and also includes the NRC staff's conclusions based on those activities. The staff's technical findings provide the framework for the final resolution of this unresolved safety issue. The final resolution will be published later as NUREG-1229. 52 refs., 4 tabs.

33589 (NUREG–1341) **Regulatory analysis for the resolution of Generic Issue 115, enhancement of the reliability of the Westinghouse Solid State Protection System.** Basdekas, D.L. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Safety Issue Resolution. May 1989. 17p. Sponsored by Nuclear Regulatory Commission. Available from NTIS, PC A03/MF A01 - GPO - OSTI.

Generic Issue 115 addresses a concern related to the reliability of the Westinghouse reactor protection system for plants using the Westinghouse Solid State Protection System (SSPS). Several options for improving the reliability of the Westinghouse reactor trip function for these plants and their effect on core damage frequency (CDF) and overall risk were evaluated. This regulatory analysis includes a quantitative assessment of the costs and benefits associated with the various options for enhancing the reliability of the Westinghouse SSPS and provides insights for consideration and industry initiatives. No new regulatory requirements are proposed. 25 refs., 11 tabs.

33590 (NUREG–1353) **Regulatory analysis for the resolution of Generic Issue 82, "Beyond design basis accidents in spent fuel pools".** Throm, E.D. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Safety Issue Resolution. Apr 1989. 114p. Sponsored by Nuclear Regulatory Commission. Available from NTIS, PC A06/MF A01 - GPO - OSTI.

Generic Issue 82, "Beyond Design Basis Accidents in Spent Fuel Pools," addresses the concerns with the use of high density storage racks for the storage of spent fuel, and is applicable to all Light Water Reactor spent fuel pools. This report presents the regulatory analysis for Generic Issue 82. It includes (1) a summary of the issue, (2) a summary of the technical findings, (3) the proposed technical resolution, (4) alternative resolutions considered by the Nuclear Regulatory Commission, (5) an assessment of the benefits and cost of the alternatives considered, (6) the decision rationale, and (7) the relationships between Generic Issue 82 and other NRC programs and requirements. Based on this evaluation, the NRC staff concludes that no new regulatory requirements are warranted concerning the use of high density storage racks. 48 refs., 32 tabs.

33591 (NUREG/CP–0097-Vol.1) **Sixteenth water reactor safety information meeting: Volume 1: Plenary session, Decontamination and decommissioning, License renewal, Human factors, Generic issues, Risk analysis/PRA applications, Innovative concepts for increased safety of advanced power reactors.** Weiss, A.J. (comp.). Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (USA). Mar 1989. 561p. Sponsored by Nuclear Regulatory Commission. (CONF-8810155–Vol.1: 16. water reactor safety information meeting, Gaithersburg, Maryland, USA, 24-27 Oct 1988). Available from NTIS, PC A24/MF A01 - GPO - OSTI.

This five-volume report contains 141 papers out of the 175 that were presented at the Sixteenth Water Reactor Safety Information Meeting held at the National Institute of Standards and Technology, Gaithersburg, Maryland, during the week of October 24-27, 1988. The papers are printed in the order of their presentation in each session and describe progress and results of programs in nuclear safety research conducted in this country and abroad. Foreign participation in the meeting included twenty different papers presented by researchers from Germany, Italy, Japan, Sweden, Switzerland, Taiwan and the United Kingdom. The titles of the papers and the names of the authors have been updated and may differ from those that appeared in the final program of the meeting. This document, Volume 1, discusses Decontamination and Decommissioning; License Renewal; Human Factors; Generic Issues; Risk Analysis/PRA Applications; and Reactor Safety.

33592 (NUREG/CR–5193) **MELPROG-POW/MOD1: A two-dimensional, mechanistic code for analysis of reactor core melt progression and vessel attack under severe accident conditions.** Dosanjh, S.S. (ed.). Nuclear Regulatory Commission, Washington, DC (USA). Div. of Systems Research; Sandia National Labs., Albuquerque, NM (USA). May 1989. 391p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC04-76DP00789. (SAND–88-1824). Available from NTIS, PC A17/MF A01 - GPO - OSTI.

The US Nuclear regulatory Commission has made the development of mechanistic models for severe accident progression a major priority. The purpose of these models is to provide detailed, best-estimate, coupled analyses of all the major phenomena involved in the reactor vessel and coolant system in the course of the accident. To meet this objective, the MELPROG computer code is being developed. This report describes the two-dimensional, pressurized water reactor (PWR) version of the MELPROG computer code, MELPROG/PWR-MOD1. Preliminary BWR work is described in this report. MELPROG is coupled to the TRAC-PF-1 RCS thermal-hydraulics code to provide an integrated analysis of the behavior of core, vessel, and reactor coolant systems during severe accidents. MELPROG treats core degradation and loss of geometry, debris formation, core melting, attack on supporting structures, slumping, melt/water interactions and vessel failure. The key element in MELPROG is the use of detailed modeling for the entire damage progression and failure sequence. Emphasis is also placed on the rates of hydrogen, steam and fission product formation, and transport to containment during the accident.

33593 (SAND–88-1721) **A safety overview of Sandia National Laboratories' reactor facilities.** Philbin, J.S. Sandia National Labs., Albuquerque, NM (USA). Apr 1989. 73p. Sponsored by DOE Environment Health & Safety. DOE Contract AC04-76DP00789. Order Number DE89012878/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

This report provides an overview of Sandia National Laboratories' safety policies and practices supporting the operation of Sandia's nuclear reactor facilities. These policies and practices have evolved from Sandia's 30 years of experience and leadership in the design, construction, and operation of steady-state and pulse research reactors. The report illustrates how Sandia has implemented DOE orders and research reactor standards with the goal of reducing risks to the lowest reasonable levels for its employees, contractors, the public, and the environment. The impact of DOE orders and standards on virtually all aspects of reactor operations and administration is illustrated. Included in the report are descriptions of safety

documentation (Technical Specifications and Safety Analysis Reports); the facility safety review system for addressing radiological protection and other environmental, safety and health issues; experiment activities; quality assurance; training and certification; and emergency planning.

33594 Knowledge-enhanced network simulation modeling of the nuclear power plant operator. Schryver, J.C. (Reliability and Human Factors Group, Engineering Physics and Mathematics Div., Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN (US)); Palko, L.E. v.v of Power plant simulation, 1988. Hetrick, D. Society for Computer Simulation, San Diego, CA (1988). (CONF-8802106--: Conference on power plant simulation, San Diego, California, USA, 3-5 Feb 1988).

Simulation models of the human operator of advanced control systems must provide an adequate account of the cognitive processes required to control these systems. The Integrated Reactor Operator/System (INTEROPS) prototype model was developed at Oak Ridge National Laboratory (ORNL) to demonstrate the feasibility of dynamically integrating a cognitive operator model and a continuous plant process model (ARIES-P) to provide predictions of the total response of a nuclear power plant during upset/emergency conditions. The model consists of a SAINT network of cognitive tasks enhanced with expertise provided by a knowledge-based fault diagnosis model. The INTEROPS prototype has been implemented in both closed and open loop modes. The prototype model is shown to be cognitively relevant by accounting for cognitive tunneling, confirmation bias, evidence chunking, intentional error, and forgetting.

33595 ESTATE. Mullens, J.A. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN (US)). v.v of Power plant simulation, 1988. Hetrick, D. Society for Computer Simulation, San Diego, CA (1988). (CONF-8802106--: Conference on power plant simulation, San Diego, California, USA, 3-5 Feb 1988).

ESTATE is an experimental expert system, written in OPS83, being developed to monitor the status of Oak Ridge National Laboratory's High Flux Isotope Reactor. ESTATE will be able to access 191 plant signals to determine the state of the plant, bring noteworthy events to the operators' attention, and maintain a record of plant operations. The current version of ESTATE is designed to track the plant through the start of a new fuel cycle.

33596 HERMIES-I. Weisbin, C.R. (Oak Ridge National Lab., Oak Ridge, TN (US)); Barhen, J.; DeSaussure, G. v.v of Proceedings of the the robots 9 conference. Society of Manufacturing Engineers, Dearborn, MI (1985). (CONF-8506106--: Robots 9 conference, Detroit, Michigan, USA, 2-6 Jun 1985).

The current status of investigations at the Center for Engineering Systems Advanced Research (CESAR) in the areas of navigation and manipulation in unstructured environments is discussed. Features needed for remote work in hazardous environments are discussed. Reviewed is ongoing research in autonomous navigation. Initial research with HERMIES-I and associated graphic simulation is described.

33597 Comparison of nuclear plant emergency plans of PB-NCC members. Kato, W.Y. (Brookhaven National Lab., Upton, NY (USA)); Hopwood, J.H. *Transactions of the American Nuclear Society (USA),* 56(1): 696-702 (1988). (CONF-870905--: 6. Pacific Basin nuclear conference, Beijing, China, 7-11 Sep 1987).

The Nuclear Safety Working Group (NSWG) of the Pacific Basin Nuclear Corporation Committee initiated cooperation among Pacific Basin areas based primarily around emergency planning. The NSWG conducted a review of the emergency response plans of members. This paper briefly reviews and makes a comparison of the emergency response plans, with particular attention on the response organization, the planning zone, and the protective action guidelines for emergencies. Although all areas have adopted the same basic elements of emergency planning and are similar, there are also variances due to different governmental structures, population densities, and available resources. It is found that the most significant difference is in the size of the emergency planning zone. The paper concludes with a discussion on possible future cooperative activities of the working group.

25 ENERGY STORAGE

Refer also to citation(s) 33650, 33651

2501 Magnetic

Refer also to citation(s) 33625

2502 Compressed Gas

Refer also to citation(s) 33625, 33796

2506 Thermal

Refer also to citation(s) 33354, 33410, 33713

33598 (ITL--8509, pp. 222-227) **Thermal analysis of heat extraction boreholes.** Claesson, J. (Lund Inst. of Technology, Lund, Sweden). Intertask Ltd., Ottawa, ON (Canada). 1985. (In English and French). (CONF-850905--: ENERSTOCK '85 - international conference on energy storage for building heating and cooling, Toronto, Canada, 22-26 Sep 1985;MICROLOG--89-00267). In *Enerstock 85. 3rd International conference on energy storage for building heating and cooling. Proceedings.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, Canada K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

During the last few years, the use of vertical boreholes for heat extraction from rock has been a very popular way to decrease the oil demand for space heating of single-family houses in Sweden. The borehole (or heat-extraction well) contains a circultion fluid that extracts heat from the rock through conduction. After the fluid passes through a heat pump and is cooled, it is reinjected into the borehole. A theoretical study of the thermal processes in the ground for both single and many interactive boreholes has been carried out. Analytical and numerical models have been developed to calculate transient temperatures and heat flows at the borehole walls and in the ground for a number of different borehole configurations, including cases with oblique boreholes. The numerical method adopted is a finite difference approach that uses a superposition of radially symmetric solutions and image techniques to obtain the correct boundary conditions and temperature distribution in the ground. The numerical and analytical methods have been used to develop a procedure for dimensioning a system with one or many boreholes. For the multiple borehole situation the long-term thermal process in the ground, including the thermal influence between different boreholes, is taken care of with numerically calculated dimensionless functions. 4 refs., 6 figs.

33599 (ITL--8509, pp. 228-232) **The effect of cyclic thermal loading on near-surface energy storage facilities.** Crawford, A.M. (Univ. of Toronto, Toronto, ON, Canada); Lau, K.C.; Radhakrishna, H.S. Intertask Ltd., Ottawa, ON (Canada). 1985. (In English and French). (CONF-850905--: ENERSTOCK '85 - international conference on energy storage for building heating and cooling, Toronto, Canada, 22-26 Sep 1985;MICROLOG--89-00267). In *Enerstock 85. 3rd International conference on energy storage for building heating and cooling. Proceedings.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, Canada K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The use of in-situ soils for the storage of heat or cold energy is becoming increasingly prevalent. A proposal that appears to have merit is one in which the energy is stored in and extracted from the ground by buried conduits which act alternatively to heat and cool the subsurface storage system. It is known that the thermal conductivity of soils is highly dependent on the moisture content of the soils. Drying of the soils causes a substantial reduction in the thermal conductivity. Typically, in near surface energy storage facilities, a reduction in the moisture content has been prevented by the construction of vapour barriers which act to retard moisture migration. The studies presented in this paper were made to examine the potential of storage systems which have no such impermeable barrier.

The effect of cyclic thermal loading on the change in moisture content and hence the thermal conductivity of the soils has been investigated. The concept used is to limit the drying of the soils by limiting the amount of heat input into the system such that the threshold moisture content at which large changes in the thermal conductivity occur is not reached. The merit of such a scheme is that the system will inherently be more economic by the elimination of the impermeable barriers. 2 refs., 10 figs.

33600 (ITL–8509, pp. 239-244) **Thermal performance of ground heat exchangers. Analytical formulas.** Hellstroem, G. (Lund Inst. of Technology, Lund, Sweden). Intertask Ltd., Ottawa, ON (Canada). 1985. (In English and French). (CONF-850905–: ENERSTOCK '85 - international conference on energy storage for building heating and cooling, Toronto, Canada, 22-26 Sep 1985;MICROLOG–89-00267). In *Enerstock 85. 3rd International conference on energy storage for building heating and cooling. Proceedings.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, Canada K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A heat store in the ground often uses a duct or channel system for heat transfer between the heat carrier fluid and the storage region in the ground. Examples of such ground heat exchangers are boreholes in rock and plastic tubes in clay. The thermal influence between adjacent ground heat exchangers is fully developed for heat extraction pulses of long duration. This is a basic process for the thermal analysis of ground heat exchangers. Analytical solutions for this process, which will be called the steady-flux regime, have been derived for a number of types of ground heat exchangers. Explicit formulas for the heat transfer capacity are obtained from these solutions. The influence of temperature variations along the flow paths is discussed. 3 refs., 5 figs.

33601 (ITL–8509, pp. 233-238) **Heat storage in clay. A technical and economical evaluation of vertical earth heat exchangers.** Hallstroem, G (Lund Inst. of Technology, Lund, Sweden); Palmgren, C.; Rydell, B. Intertask Ltd., Ottawa, ON (Canada). 1985. (In English and French). (CONF-850905–: ENERSTOCK '85 - international conference on energy storage for building heating and cooling, Toronto, Canada, 22-26 Sep 1985;MICROLOG–89-00267). In *Enerstock 85. 3rd International conference on energy storage for building heating and cooling. Proceedings.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, Canada K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The aim of this study is to investigate how the construction cost of the earth heat store is influenced by the design of the earth heat exchanger. The heat transfer capacity of the earth heat exchangers is given by analytical solutions of the conductive heat flow problem in the ground. Designs with one, two, or three U-shaped loops in the earth heat exchanger have been studied. A combination of U-shaped loops and a core of saturated sand in the earth heat exchanger is also treated. Finally, a technical and economic comparison of the different types of earth heat exchangers is given for a storage volume of 50,000 m^3. 3 refs., 3 figs., 1 tab.

33602 (ITL–8509, pp. 254-264) **The economics of different types of energy storage for large and medium space heating systems.** Margen, P. (Margen-Consult A.B., Nykoeping, Sweden). Intertask Ltd., Ottawa, ON (Canada). 1985. (In English and French). (CONF-850905–: ENERSTOCK '85 - international conference on energy storage for building heating and cooling, Toronto, Canada, 22-26 Sep 1985;MICROLOG–89-00267). In *Enerstock 85. 3rd International conference on energy storage for building heating and cooling. Proceedings.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, Canada K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The value of heat storage for space heating systems ranging in size from individual multiflat buildings to large district heating systems is examined for various time scales of storage (daily, intermediate and seasonal) and various types of base lead heat sources for charging the stores (e.g. industrial waste heat, garbage, solid fuel boilers, heat pumps, and cogeneration plants). The cost of different types of storage such as steel vessels, earth pits, rock caverns, clay stores, drilled rock stores and aquifers are examined from built, tendered and designed projects and expressed as simplified cost equations. A comparison between the value and cost of storage is used to discuss which types of stores are best suited for different tasks. Pay-back time and net saving achievable for various applications are derived. 18 refs., 9 figs., 3 tabs.

33603 (ITL–8509, pp. 265-267) **Economic aspects of borehole heat stores in Sweden.** Nordell, B. (Lulea Univ. of Technology, Lulea, Sweden); Sehlberg, T. Intertask Ltd., Ottawa, ON (Canada). 1985. (In English and French). (CONF-850905–: ENERSTOCK '85 - international conference on energy storage for building heating and cooling, Toronto, Canada, 22-26 Sep 1985;MICROLOG–89-00267). In *Enerstock 85. 3rd International conference on energy storage for building heating and cooling. Proceedings.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, Canada K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

In 1982/83 a large-scale borehole heat store was constructed at WREL, Lulea University of Technology, Sweden. The main part of the seasonal heat storage system is a rock volume of 100000 m^3. The store is connected to the district heating system. In this paper the cost of the project is presented. Based on the know-how gained by experiences of the project, the costs of a new 2 GWh and a 20 GWh borehole heat store have been estimated. The heat costs are calculated. The smaller heat store cannot compete with alternative heat production. The 20 GWh heat store is competitive with oil and electricity heat production at normal heat cost. 2 refs., 1 fig., 3 tabs.

33604 (ITL–8509, pp. 321-327) **Seasonal ice storage.** Francis, C.E. (Illinois State Univ., Normal, Il, USA); Tamblyn, R.T. Intertask Ltd., Ottawa, ON (Canada). 1985. (In English and French). (CONF-850905–: ENERSTOCK '85 - international conference on energy storage for building heating and cooling, Toronto, Canada, 22-26 Sep 1985;MICROLOG–89-00267). In *Enerstock 85. 3rd International conference on energy storage for building heating and cooling. Proceedings.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, Canada K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This paper describes the design and economic projections for an annual storage ice system designed to cool a 100,000 square foot building with a 200 ton load based on 1 ton per 500 square feet of conditioned floor space. The storage mass, located underground, will support a parking lot alongside the building. Based on initial concept tests on a 4000 cubic foot mass, it has been determined that a thermal storage mass of 450,000 cubic feet containing 50% water will support a 200 ton cooling load for 750 full load hours per year or 150,000 ton-hours. With an estimated construction cost of $350,400, this system will provide seasonal savings of $43,525 and a simple payback of 4.6 years. The cost of this system is $2.34 per ton-hour of stored capacity. Two additional designs are also included, one for a cold climate such as Edmonton, Alberta, Canada, and one for a moderately warmer climate such as Springfield, Illinois, USA. 5 refs., 4 figs., 4 tabs.

33605 (ITL–8509, pp. 328-330) **Ice water basins used as a latent heatsink in the dairy industry.** Granstroem, B.; Kjaerboe, P. Intertask Ltd., Ottawa, ON (Canada). 1985. (In English and French). (CONF-850905–: ENERSTOCK '85 - international conference on energy storage for building heating and cooling, Toronto, Canada, 22-26 Sep 1985;MICROLOG–89-00267). In *Enerstock 85. 3rd International conference on energy storage for building heating and cooling. Proceedings.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, Canada K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

To decrease the demand of power from cooling-compressors, an ice water basin can be installed. For milk pasteurization, a heat load and a cooling load occur for three to five hours a day. For cooling, temperatures around the freezing point of the water are needed, so that water can easily be used as the storage medium. The system

simply consists of pipes spread out in a concrete basin. The paper describes the components of the system, experiences of operation, and the costs as well as the savings in comparison to other systems. 2 refs., 5 figs., 1 tab.

33606 (ITL–8509, pp. 331-336) **Ice storage systems that cost less than conventional systems. A breakthrough for building owners.** Marquette, C.J. Intertask Ltd., Ottawa, ON (Canada). 1985. (In English and French). (CONF-850905–: ENERSTOCK '85 - international conference on energy storage for building heating and cooling, Toronto, Canada, 22-26 Sep 1985;MICROLOG–89-00267). In *Enerstock 85. 3rd International conference on energy storage for building heating and cooling. Proceedings.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, Canada K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Recent advances in heat transfer technology and equipment now permit engineers to design ice storage systems that are equal to or lower in first cost than conventional systems. The basic technology centers around the production of colder water to be supplied to the air cooling and distribution equipment to achieve cost savings in these areas. In terms of operating costs, the new ice storage system has approximately one-half the connected load of a conventional system. Therefore, the demand component of the utility bill is reduced proportionally. In addition, recent advances in ice storage design now permit higher refrigeration system efficiencies, resulting in energy consumption comparable to conventional systems. Therefore, the total utility bill is less than for a conventional system, particularly when time-differentiated rates are implemented. This paper will include a generic description of the heat transfer equipment in this new generation of ice storage systems, and will identify those areas of the system where capital cost savings occur. An itemized cost comparison for a typical project will be included, as well as a comparison of the total connected lead (demand and annual energy consumption). 2 figs., 3 tabs.

33607 (NEI-FI–76) **Waste heat storage and distribution using thermochemical energy storages.** Freiman, M.; Weissenberg, K. von. Kauppa-ja Teollisuusministerio, Helsinki (Finland). Energiaosasto. 1987. 48p. (In Finnish). Order Number DE89776166/JAW. Available from NTIS (US Sales Only), PC A03/MF A01;1.

This paper discusses the possibility of distributing waste heat to a far off user using transportable thermochemical energy storages. As waste hea are defined waste energy streams with a temperature between 60 deg C and 40 deg C. Energy can be stored in a thermochemical energy storage without heat losses. Phase-change materials have been taken up due to their commercial manufacture. The energyprice for heat distributed by transportable thermochemical energy storages within radius of 30 km is about 0.3 Fmk/kWh, using todays technology. Lately progress has been made to improve the heat transfer during charging and unloading, making it possible to build a more optimal energy store for short time storage.

33608 (TKK-F–B110) **Seasonal storage possibilities of cooling energy in Finland.** Peltola, S.; Lund, P. Helsinki Univ. of Technology, Otaniemi (Finland). Dept. of Technical Physics. Oct 1987. 64p. (In Finnish). Order Number DE89776172/JAW. Available from NTIS (US Sales Only), PC A04/MF A01;1.

The use of winter coldness for summertime cooling is possible in areas where the seasonal variation in the outdoor temperature is large and the winter is cold enough for making ice. The theoretical cooling capacity of ice is 0.1 MWh/cub.m. In this paper we present a feasibility study on the applicability of seasonal ice storage for cooling purposes in northern climatic conditions. The annual industrial cooling energy consumption excluding process industry in Finland is about 9 TWh and the corresponding electricity consumption of cooling devices 2.5 TWh. The most potential consumers with regard to ice storages are found in food industries where cooling energy is used at relatively high temperatures. Two types of ice storages have been studied. A system in which thin water layers are freezed subsequently, was applied to dairy processes replacing a conventional heat pump systems. In the 60 deg N weather conditions, a 5.7 m high ice block could be produced during the winter. To cover the cooling energy requirement of our reference case, a storage with 1000 m^2 floor area is needed. To compete with a heat pump system, the investment costs of the storage should not exceed 150000 USD, i.e. 30 USD/cub.m. Better economies can be expected for smaller units in farming applications. An ice storage of several independent phase change blocks, or canisters with water, was applied to an office building. The blocks were parallelepiped in shape and the thickness varied from 50 to 140 cm. In the summer time, the ice is used for precooling and during winter for preheating of fresh intake air. In conclusion, the ice storage seems to be a promising alternative for traditional cooling devices in applications where, besides the economic point of view, reliability is important and cooling is needed at relatively high temperatures. Modular, standardized and flexible designs are needed for the storages.

2509 Batteries

Refer also to citation(s) 33909, 33964, 33967, 34029, 34092

33609 (AD-A–201166/6/XAB) **In-situ infrared study of inhibitors and the solid-electrolyte interface. Final report, 1 September 1984-31 May 1988.** White, H.W. Missouri Univ., Columbia, MO (USA). 3 Aug 1988. 13p. Available from NTIS, PC A03/MF A01.

A tunable-diode laser spectrometer was constructed for the study of thin protective films and inhibitors on metals and oxides. Infrared spectra can be measured over the mid-infrared range on films and adsorbates under a wide variety of environments–ranging from in situ electrochemical cell to ultrahigh vacuum environments. The spectrometer uses a photoelastic modulator and commercially available diode lasers to make single-beam single-pass measurements of molecular vibration attributable to monolayer concentrations of molecules chemisorbed or physiosorbed on metal surfaces. It also measures bulk spectra of liquids from a single deflection in an attenuated total reflection (ATR) mode. The spectrometer, operating in the infrared reflection absorption spectroscopy (IRRAS) mode, was used to measure in-situ molecular vibrational spectra of a variety of molecular species absorbed as monolayer films on a variety of metallic substrates. Extensive studies were made for pure and diluted liquid pyridine (C_5H_5N) in the presence of an oxidized aluminum surface in an electrochemical-cell environment.

33610 (AD-A–201645/9/XAB) **Polyaniline: electrochemistry and application to rechargeable batteries. Technical report.** MacDiarmid, A.G.; Yang, L.S.; Huang, W.S.; Humphrey, B.D. Pennsylvania Univ., Philadelphia, PA (USA). Dept. of Chemistry. 1987. 8p. (TR–86-3). Available from NTIS, PC A02/MF A01.

Pub. in Synthetic Metals, Vol. 18, 393-398(1987).

This study shows that (1) reversible electrochemical oxidation of the leucoemeraldine base form of polyaniline in the pH range 1 to 4 occurs initially with no deprotonation to give the emeraldine salt; continued oxidation occurs with spontaneous deprotonation to give the pernigraniline base; and (2) a rechargeable battery employing the analytically pure emeraldine base form of polyaniline as the cathode can be constructed. This battery shows very promising features such as a capacity of 148 Ah/kg, an energy density of 340 Wh/kg, coulombic recovery Greater than 98%, good recyclability and satisfactory stand life. Polyaniline, leucoemeraldine, pernigraniling, electrochemistry, rechargeable batteries. (jes)

33611 (ANL–89/4) **Development of compressed multifoil insulation for high-temperature batteries and other applications.** Chilenskas, A.A.; Malecha, R.F.; Tummillo, A.F.; Meyer, F.J.; Missig, J.R. Argonne National Lab., IL (USA). Feb 1989. 11p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract W-31109-ENG-38. Order Number DE89012877/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The Li-alloy/FeS battery operates a >450°C and thus requires an insulated jacket for thermal management. The use of compressed multifoil confined in a light-weight, stainless steel, double-walled jacket at a pressure of less than 100 μm Hg was tested as an insulating medium for a 36-V, 8-kWh Li-alloy/FeS battery. Two battery jackets measuring approximately 48 x 28 x 85 cm were fabricated and tested in this program. Test results were encouraging. Product development and marketing are planned by Meyer Tool and Manufacturing, Inc. 2 refs., 4 figs., 6 tabs.

33612 (CONF-890421–9) **Deposition of electrolyte and cathode thin films by magnetron sputtering.** Bates, J.B.; Dudney, N.J.; Luck, C.F.; Klatt, L. Oak Ridge National Lab., TN (USA). May 1989. 15p. Sponsored by DOE Energy Research. DOE Contract AC05-84OR21400. From 91. annual meeting of the American Ceramic Society; Indianapolis, Indiana, USA; 23-27 Apr 1989. Order Number DE89013547/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A variety of ceramic materials exhibit sufficiently high ionic and mixed ionic-electronic conductivities to make them useful as electrolytes and electrodes for batteries, sensors, fuel cells, electrochemical displays, and for other applications. The ability to fabricate these materials in thin-film form offers possibilities for the development of solid state, microsized electrochemical devices that could be incorporated into integrated circuits. An example of such a device is the thin-film, rechargeable lithium battery. This cell potentially could be fabricated directly onto an IC substrate to serve as a backup power source for a CMOS-SRAM memory. We have fabricated several of these thin-film cells using magnetron sputtering and electron beam evaporation to deposit the various layers. One of these cells produced a steady current of 1 μA at 3.2 volts. The performance of such thin-film cells after many charge-discharge cycles and their long term quiescent stability depend on the properties of the cathode and electrolyte films, as well as the anode-electrolyte and cathode-electrolyte junctions. Depositing films which minimize the resistance to lithium ion transport through the cell is a major challenge in the development of practical microbattery. In this paper, we summarize some recent results on the deposition and properties of lithium-ion conducting xLi_4SiO_4:yLi_3PO_4 glass electrolyte and V_2O_5 cathode films. 12 refs., 6 figs.

33613 (LBL–26923) **New battery materials: Final report.** Huggins, R.A. Stanford Univ., CA (USA). Dept. of Materials Science and Engineering. Mar 1989. 26p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract AC03-76SF00098. Order Number DE89012845/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This program is aimed at the study of materials and phenomena related to advanced battery systems, special attention being given to secondary systems which might be useful for vehicular propulsion or utility load levelling. In particular, the objectives of this program are to understand and evaluate the important structural,thermodynamic and kinetic parameters related to the use of materials as electrolyte or electrode components in high performance secondary battery systems. In the last year, the exact nature of the individual projects studied under this program has been altered in some respects, while the overall objectives of the program have remained unchanged. In particular, previous projects involving the characterization of negative electrode components for use in lithium batteries, positive electrode components in the Li-Mo-O system for use in lithium batteries, and glassy lithium electrolytes in the Li-Si-S system have been completed and discontinued. The work undertaken during the last year falls into several categories. What follows is a report of our activities in some of these research areas. These include: the study of negative electrode materials for use in reversible sodium-based systems; the study of novel electrolyte systems for use in reversible sodium-based batteries; and the use of atmospheric pressure chemical vapor deposition for the preparation of thin film battery components. These will now be considered in turn. Several publications have resulted from this work, and are listed in the Appendix. 2 refs., 8 figs., 2 tabs.

33614 (LBL–26999) **Development of anodes for aluminum/air batteries: Solution phase inhibition of corrosion: Final report.** Macdonald, D.D.; English, C.; Urquidi-Macdonald, M. Lawrence Berkeley Lab., CA (USA); SRI International, Menlo Park, CA (USA). Chemistry Dept. Mar 1989. 37p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract AC03-76SF00098. Order Number DE89012839/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Solution-phase inhibition is a promising strategy for controlling the corrosion of the aluminum fuel in alkaline aluminum/air batteries. Development of effective inhibitors would permit the use of scrap aluminum as fuel and thereby significantly improve the economics of the battery, because the cost of the fuel would have been partly or wholly defrayed by its previous use. In this study, we explored the discharge characteristics of aluminum in inhibited and uninhibited 4 M KOH at 50°C and compared the performance of the fuel with that for two leading alloy fuels that had been evaluated in our previous work, Alloy BDW (Al-1Mg-0.1In-0.2Mn) and Alloy 21 (Al-0.2Ga-0.1In-0.1Tl). The inhibitors employed in this study, SnO_3^{2-}, $In(OH)_3$, $Ga(OH)_4^-$, MnO_4^{2-}, and binary combinations thereof, are either alloying elements of Alloys BDW and 21 or have been investigated previously. We found that potassium manganate and Na_2SnO_3 + $In(OH)_3$ are effective inhibitor systems. Particularly at high discharge rates, but at low discharge rates only manganate offers a significant advantage in coulombic efficiency over the uninhibited solution. Alloy BDW exhibits a very low open circuit (standby) corrosion rate, but its coulombic efficiency under discharge, as determined by delineating the particle anodic and cathodic reactions, was found to be no better than that of aluminum in the same uninhibited solution. Alloy 21 was found to exhibit a comparable performance to Alloy BDW under open circuit conditions and a much higher coulombic efficiency at low discharge rates, but the performance of this alloy under high discharge rate conditions was not determined. Alloy 21 has the significant disadvantage that it contains thallium. 36 refs., 14 figs., 2 tabs.

33615 **LI - reactivity of silicate glasses.** Cieslak, W.R. (Exploratory Batteries Div., Sandia National Labs., Albuquerque, NM (US)); Armstrong, N.R.; Maschhoff, B.L.; armstrong, N.R. v.v of Proceedings of the Electrochemical Society fall meeting. Volume 88-2 (extended abstracts). The Electrochemical Society, Pennington, NJ (1988). (CONF-881061–: Electrochemical Society fall meeting, Chicago, Illinois, USA, 9-14 Oct 1988).

Although silica - based papers are commonly used as separators in Li/$SOCl_2$ cells, SiO_2 is thermodynamically unstable with respect to lithium. Many silicate glasses are highly reactive with lithium. For very long-life applications (i.e. 10-15 years) and for reserve lithium technologies, the reactivity of these silicate materials is expected to become a life-limiting factor. Nonetheless, a screening study has indicated that some silica - based papers are much more resistant to lithium than others. It is difficult to study corrosion processes involving lithium using most ex situ techniques because environmental reactions alter the surface of interest. However, it is possible to investigate surface interactions with lithium using in vacuo surface analytical techniques. For example, X-ray photoelectron spectroscopy (XPS) has been used to monitor the reaction occurring when lithium is deposited on a freshly cleaved silica surface. Multiple states were found for silicon in the final product, rather than the complete reduction of SiO_2 to elemental Si. Furthermore, the resistance of sodium and potassium silicate glasses to lithium degradation was found to be greater than that of pure SiO_2.

33616 **Mathematical model of the secondary Zn/NiOOH cell.** Miller, K.G. (Applied Science Div., Lawrence Berkeley Lab., Berkeley, CA (US)); McLarnon, F.R.; Cairns, E.J. v.v of Proceedings of the Electrochemical Society fall meeting. Volume 88-2 (extended abstracts). The Electrochemical Society, Pennington, NJ (1988). (CONF-881061–: Electrochemical Society fall meeting, Chicago, Illinois, USA, 9-14 Oct 1988).

The alkaline zinc electrode has long been considered for use in high-performance secondary batteries proposed for various portable-power applications. In practice, however, the electrode has been found to fail after 100-300 cycles due to significant capacity loss. This failure is attributed to the redistribution of active material over the surface of the Zn electrode (shape change), although in some cases dendrite shorting and passivation of the electrode may also be problems. A major contributing factor to the rate of shape change is the high solubility of the discharge product, $Zn(OH)_4^{2-}$ (zincate) ion, in the alkaline electrolyte. Models have been proposed to explain shape change, but the forces driving this phenomenon remain uncertain. The oxidation/reduction reaction at the zinc electrode proceeds by the following two steps: $Zn + 4OH^- = Zn(OH)_4^{2-} - 2e^-$ (1) $Zn(OH)_4^{2-} = ZnO + 2OH^- - H_2O$ (2) The first reaction is the overall electrochemical reaction, which produces a soluble discharge product(zincate). Reaction 2 is a chemical precipitation (or dissolution) reaction that occurs when the KOH solution becomes supersaturated (or undersaturated) with zincate ion. Since the electrochemical reaction proceeds through the soluble

zincate species, the rate of precipitation and dissolution of ZnO plays an important role in determining electrode performance.

33617 Mathematical model of the secondary current distribution mechanism for Zn material redistribution. Isaacson, M.J. (Applied Science Div., Lawrence Berkeley Lab., Berkeley, CA (US)); McLarnon, F.R.; Cairns, E.J. v.v of Proceedings of the Electrochemical Society fall meeting. Volume 88-2 (extended abstracts). The Electrochemical Society, Pennington, NJ (1988). (CONF-881061–: Electrochemical Society fall meeting, Chicago, Illinois, USA, 9-14 Oct 1988).

Two mechanisms have been proposed for material redistribution in secondary Zn/ZnO cells: the electro-osmotic flow mechanism, and the secondary current distribution mechanism developed a mathematical model of the electro-osmotic flow mechanism. However a quantitative treatment of the secondary current distribution mechanism has not appeared in the literature. The purpose of this work was to develop a two-dimensional model of the Zn/ZnO porous electrode and use it to mathematically investigate the secondary current distribution mechanism. It was not the purpose to show which of the mechanisms is dominant. The model cell consists of the porous Zn ZnO electrode, an electrolyte reservoir, and the separator. The counter electrode was not included in the problem domain, and is therefore drawn with dashed lines. The Zn/ZnO electrode has 30% KOH electrolyte (before addition of ZnO) saturated with ZnO inside of the pores. The separator reduces the effective conductivity and ionic diffusivities but does not selectively influence the transport properties of individual ions.

33618 Application of transmission line analysis to porous battery electrodes. Macdonald, D.D. (SRI International, Menlo Park, CA (US)); Lenhart, S.J.; Pound, B.G. v.v of Proceedings of the Electrochemical Society fall meeting. Volume 88-2 (extended abstracts). The Electrochemical Society, Pennington, NJ (1988). (CONF-881061–: Electrochemical Society fall meeting, Chicago, Illinois, USA, 9-14 Oct 1988).

AC impedance spectra of porous nickel battery electrodes were recorded periodically during charge/discharge cycling in concentrated KOH solution at various temperatures. A transmission line model (TLM) was adopted to represent the impedance of the porous electrodes, and various model parameters were adjusted in a curve fitting routine to reproduce the experimental impedances. Degradation processes were deduced from changes in model parameters with electrode cycling time. In developing the TLM, impedance spectra of planar (non-porous) electrodes were used to represent the pore wall and backing plate interfacial impedance. These data were measured over appropriate ranges of potentials and temperature, and an equivalent circuit model was adopted to represent the planar electrode data. Cyclic voltammetry was used to study the characteristics of the oxygen evolution reaction on planar nickel electrodes during charging, since oxygen evolution can affect battery electrode charge efficiency and ultimately electrode cycle life if the overpotential for oxygen evolution is sufficiently low. Transmission line modeling results suggest that porous rolled and bonded nickel electrodes undergo restructuring during charge/discharge cycling prior to failure. The average pore length and the number of active pores decreases during cycling, while the average solid phase resistivity increases. The average solution phase resistivity remains relatively constant during cycling, and the total porous electrode impedance is relatively insensitive to the solution/backing plate interfacial impedance.

33619 Intercalation reactions of monovalent and divalent cations in V_6O_{13} single crystals. Munshi, M.Z.A. (Dept. of Chemical Engineering and Materials Science, Corrosion Research Center, Univ. of Minnesota, 221 Church St. SE, Minneapolis, MN (US)); Gilmour, A.; Owens, B.B.; Smyrl, W.H. v.v of Proceedings of the Electrochemical Society fall meeting. Volume 88-2 (extended abstracts). The Electrochemical Society, Pennington, NJ (1988). (CONF-881061–: Electrochemical Society fall meeting, Chicago, Illinois, USA, 9-14 Oct 1988).

The Li/V_6O_{13} couple has been the subject of intense research by various groups. From a secondary battery application, the key areas of interest for the cathode is defined by high electronic conductivity, high reversibility, high diffusivity (leading to high power densities), wide composition range (allowing high cell capacities) and minimal structural change with composition, and in this respect lithium satisfies most of the criteria. The theoretical energy density of the Li/V_6O_{13} couple is 890 Wh/kg, which is considerably greater when compared to some of the other intercalation cathodes such as TiS_2. This value together with the relative ease of manufacture of V_6O_{13} makes it a highly promising cathode material in rechargeable lithium batteries. However, the safety and cycle life of ambient temperature secondary lithium batteries, usually associated with the high reactivity of elemental lithium anode, poses a serious problem. This may be overcome, however, by finding alternative anodes which may be more stable and have reasonable energy densities.

33620 Evaluation of Li/CuO and Li/$Cu_4O(PO_4)_2$ D-cells. Jaeger, C.D. (Exploratory Batteries Div., Sandia National Labs., Albuquerque, NM (US)). v.v of Proceedings of the Electrochemical Society Fall meeting: Extended abstracts. Volume 87-2. The Electrochemical Society, Pennington, NJ (1987). (CONF-871027–: 172. meeting of the Electrochemical Society, Honolulu, Hawaii, USA, 18-23 Oct 1987).

Sandia National Laboratories has a number of applications requiring long-life applications (i.e. 10 year life). Spirally wound Li/CuO and Li/$Cu_4O(PO_4)_2$ (referred to as CuOP) D-cells. were evaluated by this laboratory with particular attention given to storability and chemical stability. Both systems have been reported to have very good storage characteristics which would make them excellent candidates for long-life applications. The purpose of this paper is to report some results concerning these lithium battery systems.

33621 Impedance of passive Li anodes in $SOCl_2$ solutions under low-field polarization. Delnick, F.M. (Sandia National Labs., Albuquerque, NM (US)). v.v of Proceedings of the Electrochemical Society Fall meeting: Extended abstracts. Volume 87-2. The Electrochemical Society, Pennington, NJ (1987). (CONF-871027–: 172. meeting of the Electrochemical Society, Honolulu, Hawaii, USA, 18-23 Oct 1987).

In Li/$SOCl_2$ batteries, the Li anode is covered by a passive LiCl film which inhibits the open-circuit self-discharge of the cells. However, this film can also inhibit the kinetic response of the anode during discharge. The initial ($t < 5$ msec) galvanostatic response of passive Li anodes is limited by the solid state conduction of Li^+ cations through the passive film. Thus, ohmic behavior is observed under low field (eta < 20 mV) and Tafel behavior is observed under high-field (eta> 1 V). In this report, examine the long-term ($t > 5$ msec) low-field kinetic behavior of passive Li anodes using complex impedance analysis under potentiostatic control of the electrode polarization.

33622 Optimization of reserve lithium thionyl chloride battery electrochemical design parameters. Godshall, N.A. (Sandia National Labs., Albuquerque, NM (US)); Doddapaneni, N. v.v of Proceedings of the Electrochemical Society Fall meeting: Extended abstracts. Volume 87-2. The Electrochemical Society, Pennington, NJ (1987). (CONF-871027–: 172. meeting of the Electrochemical Society, Honolulu, Hawaii, USA, 18-23 Oct 1987).

A thorough understanding of the factors affecting Reserve Lithium Thionyl Chloride (RLTC) electrochemical performance is important before initiating battery design. Previous workers have investigated individual parameters, such as high-rate cathode, performance, lithium corrosion efficiencies, and catalysis, etc. A broad parametric study of these and other variables was performed in order to optimize the performance of RLTC batteries. Seven parameters were evaluated: electrode compression, carbon thickness, presence of catalyst, temperature, electrode limitation, discharge rate, and electrolyte acidity.

33623 Zinc-redox battery, a technology update. Hollandsworth, R.P. (Lockheed Missiles and Space Co., Inc., Palo Alto, CA (US)). v.v of Proceedings of the Electrochemical Society Fall meeting: Extended abstracts. Volume 87-2. The Electrochemical Society, Pennington, NJ (1987). (CONF-871027–: 172. meeting of the Electrochemical Society, Honolulu, Hawaii, USA, 18-23 Oct 1987).

This paper details the current state of the Zinc Redox Battery technology, in which studies have concentrated upon three areas, which were identified as being most critical to continued technical progress. These were the identification of a viable, low-cost

membrane, identification of a bipolar zinc electrode candidate, reattainment of earlier zinc electrode coulombic efficiencies of >90%, and continued cell-modeling efforts. Also discussed is the system's safety and environmental advantages.

33624 Prediction of peak load time with computerized pattern recognition. Perone, S.P. (Chemistry and Materials Science Dept., Lawrence Livermore National Lab., Livermore, CA (US)); Johnston, R.; Carothers, F.; Birk, J. v.v of Proceedings of the Electrochemical Society Fall meeting: Extended abstracts. Volume 87-2. The Electrochemical Society, Pennington, NJ (1987). (CONF-871027--: 172. meeting of the Electrochemical Society, Honolulu, Hawaii, USA, 18-23 Oct 1987).

Multivariate analysis techniques such as computerized pattern recognition have been used successfully to interpret electrochemical and battery test data. In the latter case, the feasibility of battery lifetime prediction from initial test data was demonstrated. This work explores computerized pattern recognition for the prediction of daily peaks in electric power load profiles. The purpose is to develop an algorithm for control of customer-side peak-shaving battery operation. This exploratory work examined the load profile data from the Delco-Remy battery manufacturing facility in Muncie, IN. Utility power to the entire plant was monitored and compiled into a computer data base as 15-minute averaged values. The basic approach used for pattern recognition peak load prediction was to define attributes (features) of various instantaneous load/time windows during each working day. The goal was to determine if pattern recognition could distinguish between those windows which immediately preceded a peak in the load profile from those windows which did not. Initial work focused on mid-week data, because visual inspection indicated that load profile patterns for mid-week days appeared similar.

33625 Economics of electricity storage technologies. Garimella, S. (Battelle Columbus Labs., 505 King Avenue, Columbus, OH (US)); Sheppard, W.J. v.v of Proceedings of the Electrochemical Society Fall meeting: Extended abstracts. Volume 87-2. The Electrochemical Society, Pennington, NJ (1987). (CONF-871027--: 172. meeting of the Electrochemical Society, Honolulu, Hawaii, USA, 18-23 Oct 1987).

In the recent past, utilities have devoted considerable attention to load leveling strategies for reducing the reliance on peaking power plants, increasing baseload plant utilization, and deferring capacity expansion expenses. Load leveling can be accomplished using a variety of electricity storage technologies. All the technologies currently being developed operate on the same basic principle: electricity generated by the base load plants during the low demand periods is stored in the storage system in chemical, mechanical, or other forms, and this energy is subsequently discharged during the peak period to supplement the power generation in the grid. The ultimate cost to the user consists of the cost of initial generation of electricity, the cost of construction, operation and maintenance of the storage system, and the cost of the extra electrical energy that has to be produced to compensate for the storage system inefficiencies. The merits of using a storage system are evaluated based, among other criteria, on a comparison of the benefits of load leveling cited above, and the corresponding costs incurred. The objective of this paper is to estimate the total cost of generation and storage of electricity by three different technologies being developed for load leveling applications: lead-acid batteries, compressed air energy storage (CAES), and superconducting magnetic energy storage (SMES).

33626 Thermodynamics of ternary systems and its application to Li-Si-based negative electrode materials. Anani, A.A. (Dept. of Materials Science and Engineering, Stanford Univ., Stanford, CA (US)); Huggins, R.A. v.v of Proceedings of the Electrochemical Society Fall meeting: Extended abstracts. Volume 87-2. The Electrochemical Society, Pennington, NJ (1987). (CONF-871027--: 172. meeting of the Electrochemical Society, Honolulu, Hawaii, USA, 18-23 Oct 1987).

Problems associated with the use of elemental lithium as the negative electrode component in lithium-based cells have led to the investigation of binary lithium alloys as possible replacements. However, the use of these alloys with reduced lithium activities implies reduced cell voltages, and increased weight. This in turn implies a reduction in the specific energy and energy density of the cells in which they are employed. It is possible, however, to improve the performance of cells based on binary alloy negative electrodes by the addition of a third component in the electrode structure. In the case where this third component acts as to form a new matrix phase for the reactant, the ensuing cell could have better kinetics. This is the mixed-conductor matrix electrode concept. On the other hand, if it acts as a diluent, the result could be a significant change in the cell voltage and electrode capacity, depending on whether or not the third component reacts with lithium. These features may lead to increases in the specific energy and energy density. It is the influence of the ternary phase diagram geometry upon the properties of the negative electrode and cell specific energy which constitute the main focus of this paper. Furthermore, this general concept is applied to several Li-Si based ternary systems and it is found that cases can be found in which the maximum theoretical specific energy is significantly greater than that of the equivalent Li-Si binary electrode when both are compared with respect to the same positive electrode.

33627 Secondary current distribution and propagation of a wavy electrode. Chiu, S.L. (Dept. of Chemical Engineering, Illinois Institute of Technology, Chicago, IL (US)); Selman, J.R. v.v of Proceedings of the Electrochemical Society fall meeting. Volume 88-2 (extended abstracts). The Electrochemical Society, Pennington, NJ (1988). (CONF-881061--: Electrochemical Society fall meeting, Chicago, Illinois, USA, 9-14 Oct 1988).

The surface of most electrodes used in electrochemical deposition is usually not smooth, either on a macroscopic or or a microscopic scale. The surface roughness may be caused by: (1) surface pretreatment, e.g., mechanical polishing or electropolishing; (2) preferential nucleation and growth sites (dendrite formation) or preferential dissolution sites (corrosion pitting); (3) hydrodynamic effects (e.g., spiral formation at a rotating disk electrode). Usually, the surface roughness or profile has a certain periodicity. The current distribution at such "wavy" surfaces is of interest since their propagation is very important in applications such as surface finishing, electrowinning and battery charging. Because its relevance for zinc/brominc batteries, the parallel-plate flow electrode is studied in this paper. The secondary current distribution and the propagation of a two-dimensional surface with small amplitude to wave length ratio is analyzed. Different shapes of electrode profile are also studied. The effect of the corrosion reaction on the amplification or leveling of the profile is of special interest.

33628 Batteries. Cairns, E.J. (Lawrence Berkeley Lab., and Univ. of California, Berkeley, CA (US)). v.v of Proceedings of the 1987 Electrochemical Society spring meeting: Extended abstracts. Volume 87-1. The Electrochemical Society, Pennington, NJ (1987). (CONF-870560--: 171. Electrochemical Society meeting, Philadelphia, Pennsylvania, USA, 10-15 May 1987).

The field of batteries has been particularly active in recent decades. On the occasion of the 10th anniversary of the Energy Technology Group, a review of the progress for the last 10 years, and some new directions and expectations for the next 10 years is appropriate. Many new primary cells have been investigated and developed during recent years. Several have successfully entered the marketplace. Most of these are cells with lithium negative electrodes, and organic-solvent electrolytes, displaying specific energies in the 100+ Wh/kg range. A variety of active materials for the positive electrodes have ben used, including MnO_2, CF_x, $SOCl_2$, SO_2Cl_2, SO_2, V_2O_5, CuO, and FeS. Other successful primary cells incluced new version of the zinc/air cell for small-scale applications. The development of rechargeable ambient-temperature lithium cells with cycle lives in excess of 100 deep cycles has been a major challenge. The greatest progress has been made on cells using SO_2 or intercalation compounds such as TiS_2 or MoS_2 at the positive electrode. Significant problems remain with the long-term cycling of the lithium electrode, and the stability of the positive electrodes. The search for a stable, highly-conductive electrolyte continues.

33629 Acoustic wave devices for the study of electrode reactions. Ricco, A.J. (Sandia National Labs., Albuquerque, NM (US)); Martin, S.J. v.v of Proceedings of the 1987 Electrochemical Society spring meeting: Extended abstracts. Volume 87-1. The Electrochemical Society, Pennington, NJ (1987). (CONF-870560--:

171. Electrochemical Society meeting, Philadelphia, Pennsylvania, USA, 10-15 May 1987).

Acoustic wave devices provide a highly accurate means of measuring mass changes accompanying electrode reactions. Because they operate at high frequencies (> 100 MHz), the ultimate sensitivity of these devices exceeds that of the bulk quartz crystal oscillators which have been used previously to monitor electrode mass changes. Only certain acoustic modes, among them the horizontally polarized shear wave (HPSW), are suitable for propagation at a solid/liquid interface. The HPSW is launched by applying a radio frequency signal to an interdigital transducer on the surface of piezoelectric substrate. In the path of the wave is a thin film electrode on top of which is placed a miniature electrochemical cell. The HPSW propagates beneath the cell and along the surface/electrolyte interface and is detected at the receiving transducer. Changes in the mechanical properties or mass of the electrode affect the acoustic wave velocity, which is monitored with high accuracy. Mass changes accompanying such processes as electrodeposition, adsorption, dissolution, corrosion, and passivation can be monitored with sub-monolayer accuracy. As a demonstration, the electrodeposition of silver onto a thin film Pd electrode was monitored as a function of the charge passed. In addition, the dissolution of a thin Al film in 0.3% NaOH was monitored as a function of time with an estimated accuracy of 0.3A.

33630 Electrochemistry under high pressure shock compression. Morosin, B. (Sandia National Labs., Albuquerque, NM (US)); Graham, R.A.; Searcy, J.Q. v.v of Proceedings of the 1987 Electrochemical Society spring meeting: Extended abstracts. Volume 87-1. The Electrochemical Society, Pennington, NJ (1987). (CONF-870560–: 171. Electrochemical Society meeting, Philadelphia, Pennsylvania, USA, 10-15 May 1987).

The authors have carried out the first measurements ever accomplished on persistent electrochemical responses of galvanic cells under and immediately following high pressure shock compression loading. Shock pressures have been varied from 7.5 to 22 GPa in powder compact materials whose densities varied from about 40 to 65% of solid density. Increases in temperature due to rapid irreversible compression range from 150 C to 650 C. External electrical loads have been varied from open circuit to 90.2 Ohm. Electrical responses are carried out for time periods from ten nanoseconds to one millisecond. The galvanic cells studied are those typically used in thermal batteries. A single cell configuration was used consisting of a eutectic KCl-LiCl with a MgO binder electrolyte, a Li(Si) anode and a cathode formed from a mixture of FeS_2, the electrolyte and a SiO_2 binder. The electrolyte thickness was 4 mm. Shock compression loading was carried out with a standard high explosive loading system used extensively in other chemical studies. A plane wave is incident on the cell but shock wave interactions result in a radial compression pulse. A maximum pressure is reached in times of ten microseconds and release of pressure occurs in about 20 microseconds. Numerical simulation is used to specify the conditions of pressure and increase of temperature within the cell.

33631 Extension of the novel class of positive electrodes to systems having theoretical energy densities between 500 and 800 Whrs/Kg. Visco, S.J. (Lawrence Berkeley Lab., Materials and Molecular Research Div., Berkeley, CA (US)); Mailhe, C.C.; DeJonghe, L.C. v.v of Proceedings of the 1987 Electrochemical Society spring meeting: Extended abstracts. Volume 87-1. The Electrochemical Society, Pennington, NJ (1987). (CONF-870560–: 171. Electrochemical Society meeting, Philadelphia, Pennsylvania, USA, 10-15 May 1987).

The new class of novel positive electrodes for energy storage systems has been extended by the discovery of a related system involving energetic liquids with very low equivalent weights, high sodium salt solubilities, and non-corrosive behavior toward many metals. Actual laboratory cells using molten sodium anodes and beta-alumina electrolyte separators have achieved practical energy densities of 200 Whrs/Kg. The operating temperature for these cells was between 120 and 130^{0}C. Batteries of this type have been discharged at high current densities with very little time dependant polarization. These new materials have unique chemical and electrochemical properties that make them particularly desireable for application in advanced battery systems. Very few of these novel low equivalent weight cathode compounds are available commercially. Fortunately, the synthetic routes to these compounds are known and are relatively simple. The physical, chemical, and electrochemical properties of these new materials are discussed in detail in this paper.

33632 Electrochemical studies of novel positive electrode compounds. Visco, S.J. (Lawrence Berkeley Lab., Materials and Molecular Research Div., Berkeley, CA (US)); Mailhe, C.C.; DeJonghe, I.C. v.v of Proceedings of the 1987 Electrochemical Society spring meeting: Extended abstracts. Volume 87-1. The Electrochemical Society, Pennington, NJ (1987). (CONF-870560–: 171. Electrochemical Society meeting, Philadelphia, Pennsylvania, USA, 10-15 May 1987).

The discovery of an exiting new class of cathode materials for application in advanced battery systems has prompted the investigation of the electrochemical properties of these molecules. These rechargeable batteries operate at 120-150^{0}C and use molten sodium for the negative electrode and beta - alumina for the solid electrolyte. Schematically, the discharge reaction can be written as the following: 2 Na + A-A → 2 NaA. The chemical nature of A is discussed in detail. It is shown that the chemical versatility of these compounds actually gives rise to a whole class of possible cathode materials. The effects of solvents and/or electrolyte addition on the conductivity of the electrode melt is described. Corrosion measurements showed that aluminum exhibited a corrosion resistant behaviour towards the positive electrode melts. Cyclic voltammetry results will also be presented. These electrochemical observations have aided in the elucidation of the mechanisms controlling the performance of the novel high energy density batteries.

33633 The use of electrochemical and non-electrochemical methods for the determination of peroxide decomposition rate constants. Carbonio, R.E. (Case Center for Electrochemical Sciences, Case Western Reserve Univ., Cleveland, OH (US)); Tyrk, D.; Yeager, E.B. v.v of Proceedings of the 1987 Electrochemical Society spring meeting: Extended abstracts. Volume 87-1. The Electrochemical Society, Pennington, NJ (1987). (CONF-870560–: 171. Electrochemical Society meeting, Philadelphia, Pennsylvania, USA, 10-15 May 1987).

For fuel cells, metal-air batteries and industrial electrolysis applications it is attractive to have oxygen cathodes which do not use precious metal catalysts. Most of these catalysts require the presence of a high surface area carbon as a conductive support. A two electron reduction occurs on carbon in alkaline media, generating peroxide, HO_2^-: $O_2 + H_2O + 2e^- \rightarrow HO_2^- + OH^-$. The HO_2^- should be eliminated, both to decrease cathodic polarization and to prolong electrode life by preventing peroxide attack on the carbon and possibly Teflon surfaces. The decomposition of HO_2^- yields OH^- and O_2, where O_2 can be recycled via the first reaction. The electroreduction of peroxide is not assumed to proceed at a significant rate. Several methods for the determination of rate constants for the heterogeneous peroxide decomposition reaction have been used in this laboratory: 1) the audiometric (O_2 generation) method, using catalyst suspensions, 2) the rotating disk electrode (RDE) monitoring of HO_2^- concentration, using the limiting current for HO_2^- oxidation with catalyst suspensions, 3) the open circuit potential decay (OCPD) method using the gas-fed O_2 electrodes and 4) steady-state polarization, using gas-fed electrodes, in cases where the peroxide decomposition could be considered rate-determining. These methods assume that the homogeneous decomposition rates are small compared to the heterogeneous ones. The linear dependence of the decomposition rates on the weights of the suspended catalyst per unit volume of solution is evidence for such.

33634 Performance characteristics of novel, high energy density, intermediate temperature batteries. Mailhe, C.C. (Lawrence Berkeley Lab., Berkeley, CA (US)); Visco, S.J.; DeJonghe, L.C. v.v of Proceedings of the 1987 Electrochemical Society spring meeting: Extended abstracts. Volume 87-1. The Electrochemical Society, Pennington, NJ (1987). (CONF-870560–: 171. Electrochemical Society meeting, Philadelphia, Pennsylvania, USA, 10-15 May 1987).

Experimental cells have been assembled using novel positive electrodes. The cells consist of a molten sodium negative electrode separated from the positive electrode by a sodium beta-alumina

electrolyte tube. Energy densities of the as assembled cells range fro 100 to 120 Whrs/Kg. In contrast to the sodium/sulfur cell which operates between 300 and 350^{0}C, these novel secondary batteries operate at temperatures approaching the melting point of sodium (120-150^{0}C). The open circuit voltage is 2.3V. The reduction in the operating temperature from 350^{0}C to the 120-150^{0}C range, results in a considerably easier and cheaper cell assembly technology with, for example, the use of polymeric seals. The thermal management of such a system is obviously facilitated by this low operating temperature. In addition, the battery displayed very good behaviour during heating/thawing cycles. Upon dismantling, the beta-alumina tubes of cycled cells did not show any visible signs of degradation. One of the main limitation of the traditional Na/S battery is constituted by the very corrosive nature of molten polysulfides at 350^{0}C. This new system on the other hand, allows the use of aluminum metal as the current collector/container owing to its non aggressive nature towards aluminum.

33635 A new class of high energy density, intermediate temperature, batteries. Visco, S.J. (Lawrence Berkeley Lab., Materials and Molecular Research Div., Cyclotron Rd., Berkeley, CA (US)); Mailhe, C.C.; DeJonghe, I.C.; Armand, M.B. v.v of Proceedings of the 1987 Electrochemical Society spring meeting: Extended abstracts. Volume 87-1. The Electrochemical Society, Pennington, NJ (1987). (CONF-870560–: 171. Electrochemical Society meeting, Philadelphia, Pennsylvania, USA, 10-15 May 1987).

A new class of high energy and power density batteries using novel positive electrodes is described. When used in galvanic cells with molten sodium negative electrodes, the theoretical energy densities range from 350 to 500 Whrs/Kg, with open circuit voltages between 2.2 and 2.5 V. These cells operate at close to the melting point of sodium metal (120-150^{0}C), and suffer no apparent deleterious effects from freeze-thaw cycling. This new class of positive electrodes involves compounds which are inexpensive, stable, easy to synthesize an handle, and which offer an enormous range of possibilities in the exploration of new energy storage systems. Preliminary chemical and electrochemical studies have also shown these compounds to be non-corrosive towards aluminum metal.

33636 Effects of halide ions on the rate of oxygen reduction at a bare and a Nafion-coated Pt electrode. Gottesfeld, S. (Los Alamos National Lab., Los Alamos, NM (US)); Paffett, M.T. v.v of Proceedings of the 1987 Electrochemical Society spring meeting: Extended abstracts. Volume 87-1. The Electrochemical Society, Pennington, NJ (1987). (CONF-870560–: 171. Electrochemical Society meeting, Philadelphia, Pennsylvania, USA, 10-15 May 1987).

The authors have recently analyzed the performance of a rotating platinum disk electrode (RDE) coated by a recast Nafion film in the oxygen-reduction reaction (o.r.r.). These experiments were performed in aqueous sulfuric acid solutions at room temperature, as well as in 85% H_3PO_4 in the temperature range 25-75^{0}C. It was shown that for the filmed electrode the oxygen concentration near the Pt surface at equilibrium is higher than that in the bulk electrolyte. This is expected from the high solubility of oxygen in Nafion. The effect of the higher concentration of O_2 near the electrode surface on the kinetics of the o.r.r. at the filmed electrode can be described as detectable although somewhat limited: For filmed electrodes immersed in 85% H_3PO_4 at room temperature, a 20-fold increase in the oxygen concentration near the Pt surface resulted in ca. 2-fold increase of the mass-transfer-corrected o.r.r. current at a given potential vs RHE. While these results show that the role of the recast Nafion film as an "oxygen concentrator" may lead to a certain increase in the rate of the o.r.r., another feature of the filmed electrode, which be of importance, is a potentially lower sensitivity to impurities originating from the liquid electrolyte. Thus, filmed RDE's immersed in H_2SO_4 solutions (prepared from a high-purity reagent and deionized water) exhibited more stable performance in the e.r.r. following long-term immersion in the electrolyte, as compared with bare Pt RDE's. The possible origin of this behavior is the smaller sensitivity of the filmed electrodes to impurities such as traces of chloride ions. Chloride is a common impurity in electrolyte solutions.

33637 Zinc redox battery. Hollandsworth, R.P. (Electrochemical Engineering Consultants, Inc., Morgan Hill, CA (US)); Symons, P.P. v.v of Proceedings of the Electrochemical Society Fall meeting: Extended abstracts. Volume 87-2. The Electrochemical Society, Pennington, NJ (1987). (CONF-871027–: 172. meeting of the Electrochemical Society, Honolulu, Hawaii, USA, 18-23 Oct 1987).

Zinc/Redox batteries, utilizing the ferri/ferrocyanide couple as the positive electrode, and with 2-3 molar sodium hydroxide as electrolyte, have been under development by the Lockheed Space and Missiles Company (LSMC) since 1978. In the LSMC concept, both discharge products (zinc oxide and sodium ferrocyanide) and the redox charge product (sodium ferricyanide) are stored, at least in-part, in solid form external from the electrochemical cells, and cation exchange membranes are used to separate the redox posilyte and the zincate negalyte. Pumps are used to circulate the two electrolytes through the cells, and to thereby carry active materials and reaction products between the storage tanks and the cells stacks. The Zinc/Redox Battery concept is illustrated in Figure 1, which also shows the other, more-minor, components required for satisfactory operation of the system. Since 1979, R and D on the Zinc/Redox battery has been funded by the Department of Energy, with first the Lawrence Berkeley Laboratory and then Sandia National Laboratories as project managers.

29 ENERGY PLANNING AND POLICY

2901 Energy Analysis and Modeling

Refer also to citation(s) 33646, 33656, 33663, 33748, 33773

33638 (DOE/BP–1213) **The commercial audit database: A descriptive data summary: Volume 2, Appendices.** USDOE Bonneville Power Administration, Portland, OR (USA). Office of Energy Resources. Mar 1989. 443p. Sponsored by DOE Management & Administration. Order Number DE89013078/JAW. Available from NTIS, PC A19/MF A01 - OSTI; GPO Dep.

Data collected during energy use audits of 3900 commercial buildings on more than 3800 sites in the Pacific Northwest were stored, concurrently with data collection, in a computerized database. The database thus built contained 266 variables, 72 of which were inappropriate for public distribution for reasons ranging from confidentiality (for example, contract numbers and business addresses) to triviality (for example, dates when forms were received from contractors). This report displays and describes the information obtained from 3714 single-building sites in terms of three datasets derived from the raw data. Volume 1 discusses the methodologies of data collection and data improvement, describes the structure of the Commercial Audit Database and the report, and provides summary displays and descriptions of 48 selected variables. Volume 2 is a set of appendices that includes summary displays of the 194 variables from the primary dataset containing 287 checked and verified records.

33639 (DOE/EIA–0293(89)) **Directory of Energy Information Administration models 1989.** USDOE Energy Information Administration, Washington, DC (USA). Office of Statistical Standards. 24 May 1989. 91p. Sponsored by DOE Management & Administration. Order Number DE89012600/JAW. Available from NTIS, PC A05/MF A01 - GPO - OSTI; GPO Dep.

This directory contains descriptions about each basic and auxiliary model, including the title, acronym, purpose, and type, followed by more detailed information on characteristics, uses, and requirements. For developing models, limited information is provided. Sources for additional information are identified. Included in this directory are 40 EIA models active as of March 1, 1989, as well as the PC-AEO Forecasting Model Overview and the three Subsystems for the Short-Term Integrated Forecasting System (STIFS) Model. Models that run on personal computers are identified by "PC" as part of the acronym. The main body of this directory is an alphabetical listing of all basic and auxiliary EIA models. Appendix A identifies major EIA modeling systems and the models within these systems, and Appendix B identifies EIA models by type (basic or auxiliary). Appendix C lists developing models and contact persons for those models.

33640 (ESC-WR–89-06) **Using energy scenarios for policy purposes. A case study for the Netherlands.** Bruggink, J.J.C.

Stichting Energieonderzoek Centrum Nederland, Petten (Netherlands). Energie Studie Centrum. Apr 1989. 14p. Available from Netherlands Energy Research Foundation ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

Paper to be presented at the 14. Congress of the world energy conference, Montreal, Canada, 17-22 September 1989.

The National Energy Outlook for the Netherlands describes a range of plausible developments for the Dutch energy sector up to 2010. The study is based on a set of three long-run economic scenarios of the Central Bureau of Planning. For each of these scenarios three policy cases are developed representing different decisions with respect to fuel diversification. The goal of the National Energy Outlook was to provide policy makers with strategic information for policy purposes through an analysis of the economic and environmental consequences of the different scenarios and cases. A brief summary of the basic assumptions and results of the National Energy Outlook is presented. There is a discussion of the energy-economy connection through 2010, in particularly concerning the relative impact of aggregate economic growth, sectoral composition and energy savings. The fuel and technology mix is described with emphasis on the mutual interdependencies between public and private decisions. The environmental consequences of the scenarios appear to be dramatic when present policies remain unchanged. Finally, some new developments and their impact on the present study are mentioned. 7 figs., 3 refs.

33641 **Trajectory approximations for direct energy methods that use sustained faults with detailed power system models.** Sauer, P.W. (Univ. of Illinois at Urbana-Champaign, Urbana, IL (US)); Behera, A.K.; Pai, M.A.; Winkelman, J.R.; Chow, J.H. *IEEE Transactions on Power Systems (USA)*, 4(2): 499-506 (May 1989).

This paper addresses the effects of fast dynamics on direct energy methods that use a sustained fault trajectory to approximate critically cleared trajectories and the corresponding critical energies. Integral manifold concepts are used to explain why fast dynamics can destroy such an approximation. Methods to remedy this problem are given and illustrated with a 10 machine example.

2902 Economics and Sociology

Refer also to citation(s) 33136, 33262, 33625, 33640, 33647, 33656, 33657, 33663, 33677, 33680, 33802, 34500

33642 (KTM/E-D–164) **Social sciences and future studies in energy research.** Nurmela, J.; Paldanius, J.; Sairinen, R.; Tanskanen, E. Kauppa-ja Teollisuusministerio, Helsinki (Finland). Energiaosasto. 1989. 168p. (In Finnish). Order Number DE89776163/JAW. Available from NTIS (US Sales Only), PC A08/MF A01;1.

In an effort to co-ordinate and to determine the needs of the fragmentary social scientific research in the field of energy, the Finnish Ministry of Trade and Industry commissioned this survey. After discussing energy policy problems and evaluating the existing energy research policies, the survey presents the reform needs of research policy. A comprehensive bibliographical review of foreign and Finnish research serves as the basis for developing and defining the most important topics and approaches. Based on these, a proposal is made for a five-year research programme for the ministry's social-scientific energy research. The programme is entitled Energy policy: social effects, prerequisites and obstaclesand combines the points of view of social sciences and futures studies. The aim of the programme is to investigate the socieal and political implications, prerequisites, obstacles and means of (1) conserving energy, (2) developing and applying new energy production technologies and (3) implementing long-term energy policy development alternatives. The survey stresses that the investigation should be comprehensive and interdisciplinary, should take account of social and ecological factors, and should apply a variety of approaches and points of view. In addition to aiding governmental planning and corporate research and development activities, the research programme should also serve the needs of pluralistic public debate and political decision making.

33643 (NEI-NO–61) **Financial and economic analysis of bioenergy investments. Report no. 1/1988.** Lunnan, A. Norges Landbrukshoegskole, Aas (Norway). Inst. for Skogoekonomi. 1988. 248p. (In Norwegian). Order Number DE89776220/JAW. Available from NTIS (US Sales Only), PC A11;3.

An appendix is published as a special publication.

The aim of this report is to analyse: (1) How economical analysis in the bioenergy field should be carried out (2) How profitable the Norwegian bioenergy investments of today are (3) How profits may develop in the future. A literature study of 137 reports showed a variety of methods for carrying out investment analysis and various mistakes which make comparisions difficult. Microeconomic investment theory applied to the bioenergy area is discussed. More frequent use of sensitivity analysis and model techniques are suggested. The term relevant risk is found to be useful for both theoretical and practical analysis and is considered to be an important future research field. The operation models for bioenergy projects in use are still imperfect particularly with respect to covariation between cash flow and the portfolio of the investor. Pre and post tax calculations are considered essential. Theory of macroeconomic analysis technique developed. A study of 15 small wood and chip burning plants is carried out and showed large variations in energy costs. Many non-profitable projects became profitable in post tax calculations. The tax system influence is discussed. Straw burning and wood and chip burning plants were compared both economically and environmentally. Compost heat from experiment plants show that with a mild taxation this may be profitable. Various regional bioenergy projects are analysed and show varying competitive ability versus other energy carriers such as oil. The government use bioenergy and other alternative energy sources in order to decrease the oil monopoly tendencies. The future of bioenergy in Norway is discussed. 25 drawings, 59 tabs., 279 refs.

33644 (NEI-NO–62) **Appendix to "Financial and economic analysis of bioenergy investments.** Lunnan, A. Norges Landbrukshoegskole, Aas (Norway). Inst. for Skogoekonomi. 1988. 145p. (In Norwegian). Order Number DE89776221/JAW. Available from NTIS (US Sales Only), PC A07;3.

The appendix contains 5 appendices comprizing background for a literature study of various economic analysis of bioenergy projects, complete analysis of 15 wood and chip burning plants, regulations from the Skattedirektoratet (tax directorate) concerning wood and chip burning, a model and data for compost heat plants and post tax calculations based on set prices and interests. 21 drawings, 285 tabs.

33645 (PB–89-140040/XAB) **Evaluation of the 1965 economic development legislation.** Rainey, K.D.; Cotton, T.A. Appalachian Regional Commission, Washington, DC (USA). 1970. 55p. Available from NTIS, PC A04/MF A01.

The report is a brief evaluation of the Public Works and Economic Development Act of 1965 and the Appalachian Regional Development Act of 1965. The authors review the historical development of federal economic development programs; state the goals, objectives and strategies of the acts; analyze the strengths and weaknesses of the two acts, examine the acts in practice; and recommend revisions in the economic development legislation and in the practice of federal grant agencies.

2903 Environment, Health, and Safety

Refer also to citation(s) 33261, 33710, 34383, 34386, 34480, 34481, 34482, 34483, 34484, 34497, 34514, 34515, 34631

33646 (ESC-WR–89-02) **Starting points and backgrounds of calculations of the EOS-scenarios DG and GO with CO_2 emission maximum. Object subsidy project greenhouse scenarios (7002).** Okken, P.A. Stichting Energieonderzoek Centrum Nederland, Petten (Netherlands). Energie Studie Centrum. Mar 1989. 27p. (In Dutch). Available from Netherlands Energy Research Foundation ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

Calculations have been executed by means of the MARKAL-model for the Dutch energy economy with exogenous national CO_2 emission limits. Starting points are the EOS-scenarios 'Dynamic and Growth' (DG) and 'Partial Development' (Gedeelde Ontwikkeling or GO) for the period 1989-2020. The model has been adjusted for the

transport sector and altered with regard to CO_2. These alterations are discussed here. 4 figs., 37 refs., 3 tabs.

33647 (PB–89-160931/XAB) **Opportunities to assist developing countries in the proper use of agricultural and industrial chemicals. Report of the Committee on Health and Environment. Volume 1. Research paper(Final).** Conservation Foundation, Washington, DC (USA). 18 Feb 1988. 243p. Available from NTIS, PC A11/MF A01.

This report was prepared to examine opportunities for promoting the proper use of agricultural and industrial chemicals, and of alternatives such as integrated pest management. Volume one provides an overview of the economic, health, and environmental costs developing countries incur from improper pesticide and chemical use and presents detailed action recommendations for the Agency for International Development (AID). Volume two provides source information: included are sections on AID's and other donors' environmental policies, the activities of other US government agencies operating abroad, and lessons learned from integrated pest management programs, along with a 35-page bibliography.

2904 Natural Resources

Refer also to citation(s) 33659, 34512

33648 (NME–1986, pp. 89-102) **Peat land inventory. Overview, methodology and application Newfoundland.** Dawe, E.R. (Northlands Associates Ltd., St. John's, NF, Canada). Mercy Hospital and Medical Center, Chicago, IL (USA). 1986. (CONF-8611290–: Wood and peat energy conference, Gander, Canada, 17-19 Nov 1986;MICROLOG–89-01972). In *The power of alternative. Energy from wood and peat.* Available from Dept. of Mines and Energy, PO Box 4750, St. John's, NF, Canada A1C 5T7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The island portion of the province of Newfoundland and Labrador was inventoried for peatland deposits from 1978-1983. The total number of deposits mapped were 67,771, covering 1,114,990 hectares or 11% of the land mass of the island. The total volume of peat is 15.2 billion m^3, consisting of 6.8 billion m^3 of horticultural peat and 8.5 billion m^3 of fuel peat. All peat deposits have been classified into bog, fen, marsh and swamp types in accordance with the National Wetland Classification System. The data is presently being used for assessment of peat fuel potential and resource planning for the island of Newfoundland. 5 refs., 2 figs., 2 tabs.

33649 (NME–1986, pp. 1-15) **Biomass fuels for industrial, commercial and institutional use. A provincial perspective.** Graham, P.M. (Newfoundland Dept. of Mines and Energy, St. John's, NF, Canada). Mercy Hospital and Medical Center, Chicago, IL (USA). 1986. (CONF-8611290–: Wood and peat energy conference, Gander, Canada, 17-19 Nov 1986;MICROLOG–89-01972). In *The power of alternative. Energy from wood and peat.* Available from Dept. of Mines and Energy, PO Box 4750, St. John's, NF, Canada A1C 5T7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The use of woodchip fuel in Newfoundland's buildings and plants began with the CREDA program (Conservation and Renewable Energy Demonstration Agreement) in 1980. Eleven demonstration projects have proven the technical and economic viability of the combustion of green woodchips. Since 1978, the commercial viability of woodchip harvesting equipment and methods has been successfully demonstrated at the Corner Brook and Grand Falls paper mills and by other harvesting trials. The CREDA program also imitated 2 major fuel peat harvesting projects, milled peat at Bishop's Falls and sod peat at Saint Shotts. There is still scope for biomass fuels in the province. According to a study by the Energy Branch, the total investment required would be $110M; this would result in fuel savings of approximately $30M/y and would generate 12,000 person years of employment over the life of the projects undertaken, equivalent to 600 permanent jobs. A list of possible government measures is given. 2 figs., 4 tabs.

2905 Research, Development, Demonstration, and Commercialization

Refer also to citation(s) 33403, 33602, 33603, 33639, 33678, 33679, 33723, 33804, 34061

33650 (LBL–24211) **Energy Conversion and Storage Program: Applied Science Division annual report, FY 1987.** Lawrence Berkeley Lab., CA (USA). Mar 1988. 37p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract AC03-76SF00098. Order Number DE89013399/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The Energy Conversion and Storage Program has four main projects applying chemistry and chemical engineering to problems in the production of new fuels, their environmental impact, and energy storage and conversion. These projects are: electrochemical energy storage and conversion; thermal energy storage and conversion; coal-related research; and energy-related chemistry. Each of these projects focuses on transport-process principles, chemical kinetics, thermodynamics, separation processes, and organic and physical chemistry, and advanced analysis methods.

33651 (LBL–26583) **Energy Conversion and Storage Program: Applied Science Division annual report, FY 1988.** Lawrence Berkeley Lab., CA (USA). Mar 1989. 22p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract AC03-76SF00098. Order Number DE89012838/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The Energy Conversion and Storage Program applies chemistry and chemical engineering principles to solve problems in (a) the production of new synthetic fuels, (b) the development of high- performance rechargeable batteries and fuel cells, (c) the development of advanced thermochemical processes for energy storage, (d) the characterization of complex chemical processes, and (e) the application of novel materials for energy conversion and transmission. Projects focus on transport-process principles, chemical kinetics, thermodynamics, separation processes, organic and physical chemistry, and advanced analysis methods.

2906 Nuclear Energy

Refer also to citation(s) 33173, 33454, 33524, 33526, 33802, 34478

2908 Waste Heat Utilization

33652 (ESC-WR–88-28) **Industrial cogeneration and coal boilers. Description of a market potential model and calculations for different cases.** Boonekamp, P.G. Stichting Energieonderzoek Centrum Nederland, Petten (Netherlands). Energie Studie Centrum. Mar 1989. 112p. (In Dutch). Available from Netherlands Energy Research Foundation ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

Autumn 1987 the Energy Study Centre (ESC) of the Netherlands Energy Research Foundation (ECN) reported on the results of the National Energy Outlook 1987. One of the most important subjects of this scenario is the organisation of the future electric power supply, including larg-scale industrial cogeneration for the long term (2010). The beginning of 1988 a supplementary scenario study was carried out to determine the effect of the new (lower) fuel prices on the scenario results. As a result of the new Dutch incentives policy for cogeneration and abolition of the so-called 'WIR premies' (investment bonus) also supplementary calculations were carried out for the long-term effects. This working report presents an extended description of the title model and the results of the potential calculations. In addition a sensitivity analysis is presented for a number of parameters, amongst which the structure of the steam demand. 20 figs., 18 refs., 14 tabs.

2910 Conservation

Refer also to citation(s) 33750

33653 (KTM/E-D–161) **Experiences of adminstrative measures in energy conservation in buildings.** Levon, B.V. Kauppa-ja Teollisuusministerio, Helsinki (Finland). Energiaosasto.

1988. 117p. (In Finnish). Order Number DE89776164/JAW. Available from NTIS (US Sales Only), PC A06/MF A01;1.

The aim of this project has been to survey, describe and evaluate administrative measures in energy conservation in the building stock of Finland. The usage and the results of these measures have been compared with the prevailing situation in other Nordic countries. The project concentrates on the existing building stock and on new buildings, but e.g. the actual construction process is omitted. This report is based on discussions, interviews and literature. One conclusion of the work is the existence of a considerable unused Nordic synergy in the field of energy conservation in the building stock. It seems, that theree are still possibilities for growth in the export and import of ideas, experience and even products. In Iceland especially low temperature techniques and short-term energy storage are of interest. In Norway the "ENOK"-funds (ENOK = energy economy) and the developing energy auditing activities are in many ways exemplary. In Sweden energy research and information literature as well as press are in their own class. Furthermore many thorough researches in analyzing energy consumption in buildings and households excite admiration. In Sweden municipal energy planning is - despite of ongoing discussions - of great interest. In Denmark a wide energy auditing programme has been successfully carried out, and a big project in electricity conservation with many subtasks and international dimensions attracts attention. In addition to administrative measures in energy conservation also views on activities up to now are presented in this report. We hope, that these opinions, proposals and initiatives would inspire the public discussion as well as the development of public and private energy conservation activities in Finland.

33654 (LBL–23605) **Nationwide survey of energy conservation in colleges and universities: Institutional, organizational, and technical characteristics.** Vine, E.; Kammerud, R.; Carroll, W.L.; Hatfield, B.; Barnes, B.K. Lawrence Berkeley Lab., CA (USA). Aug 1988. 166p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract AC03-76SF00098. Order Number DE89012859/JAW. Available from NTIS, PC A08/MF A01 - OSTI; GPO Dep.

This report summarizes the responses to a mail survey of college and university physical plant directors carried out as part of an evaluation of the US Department of Energy's Institutional Conservation Program (ICP). The overall goal of the evaluation project is to identify the most successful conservation measures (equipment and activities) available to the institutional buildings sector. To accomplish this goal, four specific research objectives were defined: to determine the impact of the ICP grant program on fostering energy efficiency and saving energy; to determine key characteristics of institutional conservation efforts outside the federal program; to determine the technical, organizational and institutional conditions that create the opportunity for energy conservation measures to be most effective; and to identify key technology transfer opportunities. The work conducted as part of this evaluation includes a retrospective evaluation of the ICP grants program to date and recommendations for future conservation efforts in the institutional sector. This report focuses on those characteristics of colleges and universities that might be expected to influence the identification, implementation, operation, and impacts of institutional energy conservation efforts. Information about institutional characteristics was gathered through a mail survey of colleges and universities. Two mailings yielded 773 completed questionnaires out of the population of 3,434 colleges and universities, yielding a response rate of 22%. 6 refs., 49 figs., 6 tabs.

33655 (LBL–25471) **The regional energy and economic impacts of the National Appliance Energy Conservation Act of 1987.** Eto, J.H.; McMahon, J.E.; Koomey, J.G.; Chan, P.T.; Levine, M.D. Lawrence Berkeley Lab., CA (USA). Jun 1988. 20p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract AC03-76SF00098. Order Number DE89013372/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

We use the LBL Residential Energy Model to forecast the energy and economic impacts of the National Appliance Energy Conservation Act of 1987 (NAECA) for each of ten regions of the United States. The act sets minimum standards for residential appliances efficiencies. We find that NAECA will save the nation nearly $25 billion (1987 dollars) in cumulative, net present benefits by 2015. The savings of nearly 5 Quads (1 Q = 1E15 Btus) consist of reductions in electricity generation of 800 TWh (1 TWh = 1E9 kWh) or 3 Quads and in direct fuel use of almost 2 Quads. Appliance shipments will be largely unaffected by the standards. We also discuss some implications of our analysis for utilities regarding future air conditioner/heat pump shipments, future water heater fuel choice, and minimum rebates required to stimulate purchase of efficient central air conditioners and refrigerators. 14 refs., 2 figs., 9 tabs.

33656 **The economics of industrial energy conservation in the developing countries.** Anandalingam, G. (Brookhaven National Lab., Upton, NY (US)). v.v of Global energy interactions. Pachauri, R.K. The Riverdale Company, Inc. Publishers, Riverdale, MD (1987).

Energy conservation offers the opportunity to achieve significant savings in total demand in the developing countries. Studies in the industrialized countries have revealed conclusively that, from the economic and technological viewpoint, there are substantial opportunities for using energy more efficiently in all sectors of the national economy. One representative study has indicated that an average of 25% of energy-use in the US manufacturing sector could be saved through measures whose capital and life-cycle costs are less than those needed to generate equivalent amounts of energy supply. A recent World Bank report contends that short-term measures, which include small investments in implementing combustion efficiency improvements, insulation, and other housekeeping measures generally have a payback in 10 to 20 months. Even medium- to long-term measures requiring investments in retrofitting existing plants, waste heat recovery, etc., yield paybacks in 2 to 5 years. Thus energy conservation seems to be generally economical from the point of view of firms and industries. However it must be noted that there are a variety of disincentives for industrial investment in energy conservation. While actions on the supply and demand sides are appropriate, there has been no attempt, to our knowledge, to analyze the relative merits (benefits and costs) associated with each in the developing countries. In this paper the authors make a preliminary attempt to assess the relative economics of, on the one hand, implementing many different energy conservation or energy efficiency improvement measures and, on the other hand, developing domestic supply of oil and coal. They have based all their estimates on data from India and have drawn conclusions applicable to most developing countries.

33657 **Overcoming barriers to improved energy efficiency.** Kozloff, K. (Energy Div., Minnesota Dept. of Energy and Economic Development, St. Paul, MN (US)). v.v of Global energy interactions. Pachauri, R.K. The Riverdale Company, Inc. Publishers, Riverdale, MD (1987).

This paper reviews the US experience with energy efficiency programmes and discusses it similarity to the experience of developing countries. To make this task a bit less global, the State of Minnesota is used as a microcosm of public and private interventions in the US. Similarily, India is primarily shown as representing the developing world. The paper first reviews the energy situation in Minnesota. Next the barrier that prevent improvements in energy management are described. This section is followed by a discussion of issues related to Minnesota's experience with conservation programmes. The next section offers some examples from developing countries that parallel the Minnesota experience. The last section suggests some ways in which interventions could be improved in both industrialized and developing countries.

2920 Supply, Demand, and Forecasting

Refer also to citation(s) 33136, 33153, 33171, 33640, 33642, 33663, 33677, 33709, 33778, 34631

33658 (LBL–23026) **Analysis of Michigan's demand-side electricity resources in the residential sector: Volume 2, Methodology and results: Final report.** Krause, F.; Brown, J.; Connell, D.; DuPont, P.; Greely, K.; Meal, M.; Meier, A.; Mills, E.; Nordman, B. Lawrence Berkeley Lab., CA (USA). Apr 1988. 78p.

Sponsored by DOE Conservation & Renewable Energy. DOE Contract AC03-76SF00098. Order Number DE89013373/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

This study investigates the potential for demand-side management of Michigan's residential electricity use. This investigation is part of an integrated least-cost utility planning effort known as the Michigan Electricity Options Study (MEOS). We make no recommendations concerning the cost-effectiveness of the demand-side resource compared to other supply-side options; this integrated analysis will be undertaken by another work group. All analyses in this study are based on a set of scenarios covering the years 1985–2005. 8 figs., 2 tabs.

33659 (PB–89-139976/XAB) **Challenges for Appalachia energy, environment, and natural resources: a handbook of reference materials prepared by the staff of the Appalachian Regional Commission.** Appalachian Regional Commission, Washington, DC (USA). Oct 1976. 592p. Available from NTIS, PC A25/MF A01.

Errata sheet inserted.

This handbook contains reference materials that includes: essays; reprinted articles, many from the journal 'Appalachia'; and sources of environmental information. The topics include: air pollution, energy and manpower, environmental education, environmental planning and land-use planning, mine reclamation, mine safety and health, natural disasters, solid waste, timber, and water resources and land stabilization.

2930 Policy, Legislation, and Regulation

Refer also to citation(s) 33671, 33673, 33802, 34383

33660 (ASRB–1986) **5th Annual report of the Surface Rights Board appointed under the Surface Rights Act for the year 1986.** Surface Rights Board, Edmonton, AB (Canada). 1986. 11p. (MICROLOG–89-01498). Available from Alberta Legislative Library, 216 Legislature Bldg., Edmonton, AB, Canada T5K 2B6; $N/C/ CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The Surface Rights Board is responsible for administering the application process for rights of entry for mineral recovery (oil and gas), power transmission lines, and pipelines, and for determining costs and compensation related to surface rights. This report provides a summary of the applications received and actions taken during the year. 15 tabs.

33661 (DOE/DP/48058–1) **Research and development of methods and tools for achieving and maintaining consensus processes in the face of change within and among government oversite agencies: First annual performance report: Research status, October 1988–September 1989.** Kurstedt, H.A. Jr. Virginia Polytechnic Inst. and State Univ., Blacksburg, VA (USA). Management Systems Labs. 1989. 61p. Sponsored by DOE Defense Programs. DOE Contract FG02-88DP48058. Order Number DE89013509/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

In contrast to the autonomy of authoritarian rule implemented through edict and backed by force, the key defining feature of the organizations responsible for making American government work today is "polyonomy" a term we've invented to signify that responsibility and power are lodged not with any one agency but are apportioned among many agencies and subagencies. Polyonomy requires consensus backed by negotiation and persuasion. Government Oversight Agencies (GOA's) – those bodies at all levels of government (federal, state, and local) charged with implementing laws made by the Congress and by state legislatures – face the monumental but essential task of coordinating their overlapping roles and responsibilities. And that's not all. They must learn to cooperate within an environment which engenders and rewards adversariality, and they must further learn to maintain the ability to cooperate over long periods of time, to coordinate necessary adaptation to inevitable change. The need is urgent for longitudinal, real-world research on mechanisms to create and maintain processes for helping GOA's achieve quality consensus decisions. We hypothesize that consensus evolves and recycles through four phases – Planning, Building/Maintaining, Implementing, and Post-Implementation – within an external environment determined by four elements – Compulsions (Drivers), Information Gathering, Communications, and Reward Systems. 5 figs.

2940 Fossil Fuels

Refer also to citation(s) 33133, 33151, 33152, 33153, 33171, 33172, 33395, 33677, 33778

33662 (AD-A–201561/8/XAB) **Project PETROL RAM: Improving the management of Air Force fuels operations and inventories. Master's thesis.** Frederick, P.R. Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). Sep 1988. 94p. (AFIT/GLM/LSM–88S-20). Available from NTIS, PC A05/MF A01.

The purpose of this research was to provide a handbook on Project PETROL RAM and its ideas for enhancing the base-level fuels operations. This handbook is to serve as an introduction and reference guide to the components, characteristics, and capabilities of the proposed initiative. In preparing this handbook, available information on the structure, operations, and procedures of a typical base Fuels Management Branch was gathered, then condensed and simplified. For added depth and understanding, personal interviews with personnel involved in the design and development of this project were conducted. The research resulted in a handbook that describes, in simplified terminology, the different systems which are being developed under the Project PETROL RAM initiative.

33663 Demand elasticities for petroleum products in Sri Lanka. DeSaram, P.S.P.S. (Ceylon Refineries Ltd., Colombo (LK)); Anandalingam, G.; Mubayi, V. v.v of Global energy interactions. Pachauri, R.K. The Riverdale Company, Inc. Publishers, Riverdale, MD (1987).

In this paper, a preliminary attempt has been made to model demand for four petroleum products - gasoline, kerosene, auto-diesel, and heavy (industrial) diesel-in terms of a simple model incorporating income and product prices as explanatory variables. Gasoline and kerosene declined over the period 1965-1981 while auto diesel consumption considerable increased. Heavy diesel, which is used for diesel electric generation and industrial uses, declined till 1976, then recovered somewhat and fell again in 1981. Per capita product demand over the 1965-81 period was regressed on per capita income and retail product prices, both evaluated in terms of constant (1959) prices (in the case of auto-diesel and gasoline, an additional variable, the number of diesel and gasoline vehicles, was included). The model is described in length in this paper. Also discussed, the results, including the income and price elasticities obtained from the regressions, their significance, and suggestions for extension of the calculation on. Although the model is simple and suffers from numerous inadequacies, discussed at length, the results of the elasticity estimations are of some intrinsic interest because this is the first such calculation for Sri Lanka and comparisons with the same parameters estimated for other oil-importing developing countries yield some insight into inter-country differences in the factors affecting petroleum consumption.

2960 Electric Power

Refer also to citation(s) 33173, 33451, 33625, 33674, 33738, 34168

33664 (DOE/EIA–0226(89/03)) **Electric power monthly, March 1989.** USDOE Energy Information Administration, Washington, DC (USA). Office of Coal, Nuclear, Electric and Alternate Fuels. 15 Jun 1989. 178p. Sponsored by DOE Management & Administration. Order Number DE89014645/JAW. Available from NTIS, PC A08/MF A01 - OSTI; GPO Dep.

The Electric Power Monthly (EPM) is prepared by the Electric Power Division; Office of Coal, Nuclear, Electric and Alternate Fuels; Energy Information Administration (EIA); Department of Energy. The purpose of this publication is to provide energy decisionmakers with accurate and timely information. The EPM presents monthly summaries of electric utility statistics at the national, Census division, and State level for net generation, fuel consumption, fuel stocks, quantity and quality of fuel, cost of fuel, electricity sales, and retail prices of electricity. Data on net generation are also displayed at

the North American Electric Reliability Council (NERC) region level. Additionally, company and plant level information are published in the EPM on capability of new plants, net generation, fuel consumption, fuel stocks, quantity and quality of fuel, and cost of fuel.

33665 (EPRI-GS–6401) **The DYNAMICS model for measuring dynamic operating benefits.** Grimes, R.C.; Jabbour, S.J. Electric Power Research Inst., Palo Alto, CA (USA); Decision Focus, Inc., Los Altos, CA (USA). c Jun 1989. 149p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

This report describes the EPRI computer model, DYNAMICS, which is being developed to calculate the dynamic operating costs of power systems and the dynamic operating benefits of power generation technologies that provide operating flexibility at minimal costs. 30 refs., 30 figs., 28 tabs.

33666 (LBL–25473) **Statistical indicators of potential for electric utility least-cost planning programs.** Eto, J.H.; Koomey, J.G.; Chan, P.T.; Yen-Wood, W. Lawrence Berkeley Lab., CA (USA). Jul 1988. 31p. Sponsored by DOE/CE;DOE/MA. DOE Contract AC03-76SF00098. Order Number DE89012854/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The goal of this project is to examine the potential for LCUP (least-cost utility planning) by estimating when and where demand-side measures can make a difference in utility resource plans. We make this assessment by linking utility interest in LCUP to a variety of economic and regulatory factors that influence utility resource planning decisions. We have developed two sets of indicators: economic indicators that describe the electricity demand and supply picture by NERC regions and states; and regulatory indicators that summarize the institutionalization of some kind of least cost planning process by state. 14 refs., 15 figs., 3 tabs.

33667 (LBL–26165) **Structural evolution of the electric utility industry.** Kahn, E. Lawrence Berkeley Lab., CA (USA). Oct 1988. 21p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract AC03-76SF00098. Order Number DE89013368/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The electric utility industry is presently dominated by companies which are vertically integrated monopolies that generate electricity, own and operate the transmission system, and provide distribution services to end users. However, the success of privately-owned generation plants that have developed as a result of the Public Utilities Regulatory Policy Act (PURPA) provides strong evidence that competition is both possible and desirable. The viability and efficiency of PURPA producers means that natural monopoly conditions in generation are no longer operative. FERC's recent Notices of Proposed Rulemaking (NOPR) aims to encourage competition by easing the entry of additional players into electricity supply markets (i.e., independent power producers). Competitive processes are fundamentally decentralizing. More decision-makers will be involved than under a regime of vertically-integrated regulated monopolies. The technical characteristics of electric power systems require real-time coordination and the centralized control of power plants is necessary to assure economic and reliable system operations. This study explores the organizational consequences of the end of vertical integration, and specifically looks at a future electric power industry which includes a competitive generation segment (made up of GENCOs) and regulated distribution companies (DISCOs). Three major topics are discussed: (1) the bulk power transmission system and implications of DISCO versus GENCO ownership and control, (2) the planning and operating environment in a decentralized industry structure, and (3) the dynamics of asset reallocation. 25 refs., 1 tab.

33668 (LBL–26166) **Electricity in the developing countries: Trends in supply and use since 1970.** Meyers, S.; Sathaye, J. Lawrence Berkeley Lab., CA (USA). Dec 1988. 62p. Sponsored by DOE Environment Health & Safety. DOE Contract AC03-76SF00098. Order Number DE89013390/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

The purpose of this report is to provide an overview of historic trends and the current situation concerning electricity supply and consumption in the developing countries (LDCs). While these countries still account for a relatively modest share of world electricity production, their demand for electricity is growing at a much faster rate than that of the industrialized countries. Thus, the power sector in the LDCs will become increasingly important as a consumer of energy ad a producer of carbon dioxide. The share of world electricity production account for by the developing countries grew form 11% in 1970 to 20% in 1986 (See Figure 1.1). The average annual growth rate for LDC electricity production in this period — 8.4% — was over twice the rate of 3.8% recorded in the "developed" countries (OECD and others). The share of LDC electricity production derived from fossil fuels has remained at about 65% since 1970 (See Figure 1.2). In contrast, the fossil fuel dependency of electricity production in the industrialized countries has declined from 76% to 64% as a result of growing use of nuclear power. In the LDCs as in the industrialized countries, there has been a shift away from oil to coal, natural gas, and to a lesser extent, nuclear power. 7 refs., 23 figs., 16 tabs.

33669 (LBL–26212) **Welfare and efficiency benefits of all sources bidding.** Kahn, E. Lawrence Berkeley Lab., CA (USA). Oct 1988. 19p. Sponsored by DOE Management & Administration. DOE Contract AC03-76SF00098. Order Number DE89012857/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This study examines the impact of competitive bidding for new generating capacity on the electric utility industry. Competitive bidding for new generating capacity is a reform of the regulatory process designed to improve the efficiency of electricity production. Individual states have experimented with a number of schemes which aim at improving efficiency incentives (Joskow and Schmalensee, 1986). The bidding approach has been taken up at the federal level as well as by particular states. To make the analysis concrete, we focus on the impact of the Notices of Proposed Rulemaking (NOPR) issued by the Federal Energy Regulatory Commission (FERC) in March 1988 on bidding and independent power producers. In the two NOPRs, FERC proposes guidelines for power purchase auctions that will also involve reduced regulation for a class of wholesale generation suppliers known as Independent Power Producers (IPPs). IPPs are defined as entities that are selling from facilities that are not regulated on a cost-of-service basis, that do not control transmission facilities essential to the buyer, and, if they are a franchised utility, are selling to buyers outside their retail service territory. The essence of the FERC proposals is that IPPs be part of the auction process; hence the term "all sources bidding." 28 refs.

33670 (LBL–26374) **Review of the demand-side management plans of four New York utilities.** Goldman, C.; Kahn, E. Lawrence Berkeley Lab., CA (USA). Feb 1989. 27p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract AC03-76SF00098. Order Number DE89012837/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

In this study, we review the DSM (Demand Side Management) plans of four utilities: Consolidated Edison (Con Ed), Rochester Gas & Electric (RG&E), New York State Electric and Gas (NYSEG), and Niagara Mohawk Power Company (NMPC). The study begins with an overview of the evaluation framework for DSM planning and a summary of the current load/resource balance of the NY utilities in order to provide a yardstick and context for our review of the four utility plans. We then examine the DSM plans of the individual utilities in some detail: the technical and market potential for conservation, cost-effective programs in each sector, relative impact on future load growth, and efficiency options that are not included in the plans. Finally, we offer some suggestions for improving DSM plans in the areas of data reporting, data quality, and analysis/methodology. 33 refs., 9 tabs.

33671 **Meeting future electricity needs.** Hirst, E. (Oak Ridge National Lab., TN (USA)). *Forum for Applied Research and Public Policy (Knoxville, Tennessee)(USA)*, 3(3): 26-34 (Fal 1988).

Integrated resource planning is as complicated and difficult as it is important. Substantial progress is being made by utilities and their regulators in several states. Nevertheless, we are still in the learning stage. We lack adequate data to characterize many of the important options (especially those related to the acceptance of demand-side programs). We also need to improve our ability to analyze the effects of uncertainty on the benefits and costs of various resource decisions. State PUCs, which play a critical role in reviewing and

approving these plans, need to define better their roles and responsibilities. Finally, we need to implement the decisions suggested by the integrated resource planning process and monitor results to track the relationship between reality and plans. The outcomes of integrated resource plans and planning are likely to reduce energy-service costs, increase utility and regulatory flexibility, and generate fewer controversies over future resource acquisitions. Such benefits are well worth the effort. 13 references, 2 figures, 1 table.

2980 Consumption and Utilization

Refer also to citation(s) 33172, 33451, 33658, 33664, 33712

33672 (DOE/EIA–0314(87)) **Housing characteristics, 1987: Residential Energy Consumption Survey.** USDOE Energy Information Administration, Washington, DC (USA). Office of Energy Markets and End Use. 26 May 1989. 264p. Sponsored by DOE Management & Administration. Order Number DE89014621/JAW. Available from NTIS, PC A12/MF A01 - GPO - OSTI; GPO Dep.

This report is the first of a series of reports based on data from the 1987 RECS. The 1987 RECS is the seventh in the series of national surveys of households and their energy suppliers. These surveys provide baseline information on how households in the United States use energy. A cross section of housing types such as single-family detached homes, townhouses, large and small apartment buildings, condominiums, and mobile homes were included in the survey. Data from the RECS and a companion survey, the Residential Transportation Energy Consumption Survey (RTECS), are available to the public in published reports such as this one and on public use tapes. 10 figs., 69 tabs.

33673 (GRS–379(1)) **Stabilizing of the energy consumption in Norway.** Dale, E.; Ekelund, T. Gruppen for Ressursstudier, Oslo (Norway). Sep 1981. 26p. (In Norwegian). Order Number DE89776215/JAW. Available from NTIS (US Sales Only), PC A03/MF A01;1.

The idea of stabilizing energy consumption in Norway arose in the 1970ties and includes stabilizing all energy resource consumption. The aim of stabilization has been taken into all parliamentary party programs through the environment conservation movements and the political youth organizations. However, the perspectives are somewhat altered in some political parties. "Stabilizing" was connected to a temporary leveling of the energy consumption based on the use of energy conservation potentials without fundamentally halting the consumption growth of other resources. The party arguments for stabilization are connected to negative environmental effects from energy consumption based on energy carriers and technology of today. Another point is a desire for reduced use of stored resources. Some parties connect the desire for another society structure with the stabilizing of energy consumption. Most parties wish to tie up stabilizaton of energy consumption with the part of energy flow comprizing the energy content of home commodity and service consumption including imports. This will require commercial policy measures. The largest energy conservati- onist organization, the political center and left-wing parties, want a stabilization before 1990, the conservative party during 1990 and the Labour party in the future. There are no definite views on stabilization level. All parties want to turn consumption to renewable from nonrenewable energy carriers. Those desiring a stabilization before 1990, want a larger energy conservation effort and use of renewable energy carriers such as the sun, wawe, wind, and biomass. 1 drawing.

33674 (LBL–23025) **Analysis of Michigan's demand-side electricity resources in the residential sector: Volume 1, Executive summary: Final report.** Krause, F.; Brown, J.; Connell, D.; DuPont, P.; Greely, K.; Meal, M.; Meier, A.; Mills, E.; Nordman, B. Lawrence Berkeley Lab., CA (USA). Apr 1988. 7p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract AC03-76SF00098. Order Number DE89013370/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This report assesses the technical and economic potential for electricity conservation in Michigan's residential sector. We have investigated a wide range of technologies to reduce energy use and estimated the statewide impact of their implementation with respect to energy savings and costs. We present the results in terms of the "cost of conserved electricity," which permits simple, consistent comparisons among demand-side measures and between demand- and supply-side options. The results of this report, while important in themselves because they demonstrate large potential electricity savings, are designed to serve as part of a larger, integrated assessment of Michigan's electricity resource options. For this reason, we make no recommendations regarding the selection of demand-side measures over supply-side measures or the optimal mix. However, we present typical electricity costs to provide readers a reference point for judging the measures themselves. We also discuss the merits of one demand-side measure relative to another. This report builds on the rapidly increasing experience in demand-side management in Michigan and the United States. At the same time, it has several features that are unique. We assessed the programs to deliver the energy efficiency technologies as well as the technologies themselves. This permits a much more realistic assessment of the measures, including the costs to administer a program, and the rates at which the electricity savings will become available. We also investigated the impact of these demand-side measures on the major utilities' load shapes. We developed an indicator of cost-effectiveness, the "cost of conserved power" to permit a simple comparison with the cost of supplying power. Again, however, the selection of the optimal mix of demand and supply-side options is left to the integrated analysis. 3 figs.

33675 (LBL–23027) **Analysis of Michigan's demand-side electricity resources in the residential sector: Volume 3, End-use studies: Revised final report.** Krause, F.; Brown, J.; Connell, D.; DuPont, P.; Greely, K.; Meal, M.; Meier, A.; Mills, E.; Nordman, B. Lawrence Berkeley Lab., CA (USA). Apr 1988. 251p. DOE Contract AC03-76SF00098. Order Number DE89013404/JAW. Available from NTIS, PC A12/MF A01 - OSTI; GPO Dep.

This volume of the "Analysis of Michigan's Demand-Side Electricity Resources in the Residential Sector" contains end-use studies on various household appliances including: refrigerators, freezers, lighting systems, water heaters, air conditioners, space heaters, and heat pumps. (JEF)

33676 (LBL–25558-Rev.) **Technology assessment: Electronic office equipment: Revision.** Harris, J.; Roturier, J.; Norford, L.K.; Rabl, A. Lawrence Berkeley Lab., CA (USA). Nov 1988. 43p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract AC03-76SF00098. 6-09-0118. Order Number DE89013375/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Electronic office equipment represents a fast-growing but poorly understood component of the "other" end use in commercial buildings. We analyzed technical data and market projections to characterize the electricity usage and efficiency potential for this equipment. There were no published data on actual power consumption of office equipment, so we metered selected pieces of equipment, for comparison with nameplate ratings. Measured power use was typically 20–40% of nameplate ratings. Power use varies for similar equipment; in particular, desktop PCs use about ten times the power of equivalent laptop models. Typical daytime loads for office equipment are about 10–20 W/m_2, roughly equal to lighting loads in a well-designed new office. Future load growth depends on many market and technical factors; US office equipment electricity use in 1995 could range from 130 TWh ("market saturation" of current technology with expanded use of computerized printing) to about 25 TWh if today's most efficient hardware and operating systems became the market norm. 45 refs., 5 figs., 4 tabs.

33677 **Energy demand and energy efficiency in the developing countries.** Sathaye, J. (Lawrence Berkeley Lab., Berkeley, CA (US)); Ghirardi, A.; Meyers, S.; Schipper, L. v.v of Global energy interactions. Pachauri, R.K. The Riverdale Company, Inc. Publishers, Riverdale, MD (1987).

The objective of this study is to improve our understanding of the determinants of energy-use patterns in the developing countries. The patterns of growth in energy-use observed during the past decade suggest that most of the growth in energy-use will occur in the developing countries. During the 1970's, energy-use in the developing countries increased at an average annual rate of 6.6%, which is more than four times the rate observed in the developed market economies. Additionally, imports of oil and other fuels are

closely related to the socio-economic progress and the financial stability of the developing countries. The tenfold increase in oil prices during the past decade has focussed attention on energy-use that continues, in spite of the decline in dollar price of oil. Therefore, it is important to evaluate the factors that would determine the need for energy in these countries.

2990 Unconventional Sources and Power Generation

Refer also to citation(s) 33366, 33395, 33403

33678 Technology transfer at the Solar Energy Research Institute. Rubin, S. (Technical Assistance Service, Solar Energy Research Institute, Golden CO (US)). v.v of Solar '88 (Technical Papers). Coleman, M.J. American Solar Energy Society, Boulder, CO (1988). (CONF-880615--: Solar '88: American Solar Energy Society annual meeting and 13th national passive solar conference, Cambridge, Massachusetts, USA, 18-24 Jun 1988).

How does one communicate and use scientific and technical information effectively? This has been a concern to both government and private industry for a long time. It is a serious and growing problem because of the steadily expanding volume of scientific and technical information; because of the emergence of new disciplines and of links between existing ones; because of the increasing number and diversity of user groups and user needs.

33679 Energizing the middle school curriculum. LaHart, D.E. (Florida Solar Energy Center, 300 State Road 401, Cape Canaveral, FL (US)). v.v of Solar '88 (Technical Papers). Coleman, M.J. American Solar Energy Society, Boulder, CO (1988). (CONF-880615--: Solar '88: American Solar Energy Society annual meeting and 13th national passive solar conference, Cambridge, Massachusetts, USA, 18-24 Jun 1988).

The Florida Solar Energy Center (FSEC) conducts important and relevant research in the broad areas of solar energy technologies, methods of improving energy efficiency and energy conservation. One method of disseminating these results is to develop instructional materials that teach science research methods and process skills. These materials also provide useful information about energy and the results of current research. The Florida Middle Schools Energy Education Project (FMSEEP) is a cooperative venture among FSEC, the Governor's Energy Office and several Florida utilities, especially Florida Power and Light Co. This paper provides the rationale behind the project, a description of the instructional materials, how they were developed and evaluated and finally, gives the formula for conducting successful workshops to implement the program.

33680 Wood. Talib, A. (The MITRE Corp., McLean, VA (US)); Bienstock, D. v.v of Global energy interactions. Pachauri, R.K. The Riverdale Company, Inc. Publishers, Riverdale, MD (1987).

The sharp rise in oil prices, about tenfold in constant dollars since 1972, has resulted in rapid adjustment of consumption practices and serious consideration for alternative fuels in the highly developed, industrialized countries as well as in many developing countries. This paper describes the deteriorating balance-of-payments situation for net oil importing developing countries. The petroleum balance of payments directly reflects the increased cost of imported oil. The overall balance of payments incorporates the effects of these prices and world economic conditions on the world trade position. It is obvious that the developing countries should take effective measures to reduce their dependence on petroleum imports in order to maintain their economic progress. The dependence on petroleum imports can be reduced by a combination of specific actions. These are: Increase in domestic petroleum production, if any; use of alternative fuels as substitutes for petroleum-derived fuels; and expansion of efforts to use energy efficiently.

30 DIRECT ENERGY CONVERSION

Refer also to citation(s) 33641, 33650, 33651

3001 MHD Generators

33681 (DOE/PC/79670–1) **MHD seed recovery and regeneration: Phase 1, Evaluation of bench-scale results: First quarterly report, September 28–December 31, 1987.** Babcock and Wilcox Co., Alliance, OH (USA). Research and Development Div. Apr 1988. 19p. Sponsored by DOE Fossil Energy. DOE Contract AC22-87PC79670. Order Number DE89012646/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Progress on the MHD Seed Recovery/Regeneration, Phase 1 project for the abbreviated quarter September 28 through December 31, 1987, centered on the assembly of the project team, including issuance of subcontracts and allocation of authorized funding. Work has begun assembling laboratory test equipment and shakedown testing at Westinghouse and ANL. The team members attended a kickoff, get-acquainted meeting at PETC. The Management Plan is under preparation.

33682 (DOE/PC/79670–2) **MHD seed recovery and regeneration: Phase 1, Evaluation of bench-scale results: Second quarterly report, January 1–March 31, 1988.** Babcock and Wilcox Co., Alliance, OH (USA). Research and Development Div. May 1988. 20p. Sponsored by DOE Fossil Energy. DOE Contract AC22-87PC79670. Order Number DE89012647/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Progress on the MHD Seed Recovery/Regeneration, Phase 1 project for the quarter January 1 through March 31, 1988, centered on the assembly of the laboratory test equipment and shakedown testing at Westinghouse and ANL. Initial testing by Westinghouse has narrowed the temperature range where reduction will occur without melting. 2 figs.

33683 (DOE/PC/79670–3) **MHD seed recovery and regeneration: Phase 1, Evaluation of bench-scale results: Third quarterly report, April 1–June 30, 1988.** Babcock and Wilcox Co., Alliance, OH (USA). Research and Development Div. Aug 1988. 20p. Sponsored by DOE Fossil Energy. DOE Contract AC22-87PC79670. Order Number DE89012644/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Under the current contract, the Babcock and Wilcox Company (B and W) and its subcontractors, Westinghouse Electric Corp. and the University of Tennessee Space Institute (UTSI) and its associate, Argonne National Laboratory (ANL) will carry out Phase 1 of a two phase study of an MHD Seed Recovery Process. The process is based on the reduction of the potassium-sulfur compounds in the spent seed/ash mixture to the sulfide in a near adiabatic step. This is followed by the release of sulfur using carbon dioxide from flue gas and conversion of the resulting gaseous sulfur compounds to elemental sulfur. Phase 1 includes bench-scale investigations of two alternative reduction steps and two alternative sulfur release steps. The results of these studies will be used as part of the input to design a proof-of-concept plant and to estimate the cost of a commercial scale plant. During this reporting period, April 1 through June 30, 1988, the evaluation of the two reduction steps has been completed. Work on the sulfur release has been initiated. Progress made in these areas is presented in this report. 3 tabs.

33684 (DOE/PC/79670–4) **MHD seed recovery and regeneration: Phase 1, Evaluation of bench-scale results: Fourth quarterly report, July 1–September 30, 1988.** Babcock and Wilcox Co., Alliance, OH (USA). Research and Development Div. Nov 1988. 24p. Sponsored by DOE Fossil Energy. DOE Contract AC22-87PC79670. Order Number DE89012645/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

All activity under Phase I of this contract have been completed during this quarter. The final Phase I report and a proposal modification for Phase II will be submitted to DOE/PETC on October 15, 1988. There will be no further activity until a release to proceed with Phase II is received. The results of the Phase I bench scale evaluation have shown the B and W Seed Regeneration Process to be a technically feasible approach to MHD seed recovery and recycling. The Proof-Of-Concept plant required to demonstrate the process on a continuous basis has been designed and the cost of building it estimated. This plant should be built adjacent to the CFFF to maximize the number of recycles of seed. This will permit evaluation of

the effect of impurities to confirm the theoretical studies in the report. The seed will be regenerated in an environmentally acceptable manner no hazardous process or waste streams. Sulfur will be recovered as a marketable byproduct. The regenerated seed will be anhydrous potassium carbonate with a purity of about 95% and a recovery efficiency greater than 90%. It has been shown that impurities must reach fairly high levels (e.g. 10% as KCl) before they will have a significant effect on the cost of electricity. 2 figs.

33685 (DOE/PC/79671–T1) **MHD [magnetohydrodynamics] seed recovery and regeneration based on the Formate Process: Quarterly technical progress report, September 18, 1987–December 31, 1987.** Sheth, A.; Holt, J.; Rasnake, D.; Solomon, R.; Wilson, G.; Herrigel, H. Tennessee Univ., Tullahoma, TN (USA). Space Inst. 1987. 18p. Sponsored by DOE Fossil Energy. DOE Contract AC22-87PC79671. Order Number DE89008564/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Phase I of a two phase study using the Formate Process as the preferred option for seed regeneration is discussed. On a bench scale level, efforts will be made to evaluate and determine the formate reactor configuration, overall reaction rate and conversion, optimum operating conditions, etc., that will be necessary to design a Proof-of-Concept (POC) scale reactor. Efforts will also be made to evaluate the need for the proper type of dryers, and solid-liquid separation devices that may be required in the POC plant. We also plan to assess the potassium recovery from various spent seed containing fractions to determine the potential of recovering over 90% of the potassium. By analyzing the product and gas streams resulting from the formate reactor, we will also evaluate the possible environmental impacts. Efforts were made in refining/re-evaluating the process configuration and feed stream definitions; designing, procuring and constructing bench scale test equipment, developing an overall test plan for bench scale testing; and performing some initial shakedown tests. 4 figs.

33686 (DOE/PC/79672–T2) **MHD seed recovery/regeneration, Phase 1: Quarterly report, April–June 1988.** TRW Space and Technology Group, Redondo Beach, CA (USA). Applied Technology Div. 15 Sep 1988. 11p. Sponsored by DOE Fossil Energy. DOE Contract AC22-87PC79672. Order Number DE89012590/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Data was obtained during the past quarter defining each step of the Econoseed Process with sufficient information to design and cost a Proof of Concept test plant as well as prepare a conceptual design and cost estimate for a 300 MW(t) first commercial plant. A direction letter was received from the DOE contracting officer specifying exact details for preparation of the subject engineering designs and cost estimates as well as the proposal format. 1 fig.

3003 Thermoelectric Generators

33687 (SAND–88-3408C) **Thermoelectric terminology in metrology and standards.** Reed, R.P. Sandia National Labs., Albuquerque, NM (USA). 1989. 18p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890773–1: National Conference of Standards Laboratories (NCSL) annual conference and symposium, Denver, Colorado, USA, 9-13 Jul 1989). Order Number DE89011512/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

In metrology and standards, thermoelectricity is most often associated with thermometry. Therefore, this paper emphasizes thermoelectricity in thermometry and it focuses on the Seebeck effect. Yet, the thermoelectric terminology applies generally to all the diverse areas in which Seebeck, Peltier, and Thomson thermoelectric effects are encountered. The literature of thermoelectricity is cluttered with false notions and inapt terminology. This paper attempts to discriminate between authentic and spurious views of thermoelectricity as they relate to thermometry. As inappropriate models and nomenclature can degrade the quality of thermometry in practice, the goals of this paper are: (1) to illustrate the commonplace contradictions between some present day thermoelectric definitions and terminology, (2) to present a consistent rational basis for thermoelectric terminology, (3) to offer a general, physically realistic, and internally consistent set of definitions of the field of applied thermoelectricity, and (4) to describe practical consequences of inappropriate terminology. 26 refs., 1 tab.

3005 Fuel Cells

Refer also to citation(s) 33342, 33609, 33623, 33633, 33637, 33707, 33708, 33966

33688 (LBL–25492) **Electrochemical evaluation of new fluorosulfonic and fluorophosphonic acids as fuel cell electrolytes: Annual report, April 1987–April 1988.** Saffarian, M.H.; Ross, P.N. Lawrence Berkeley Lab., CA (USA). Jun 1988. 50p. DOE Contract AC03-76SF00098. 5086-260-1229. (GRI–88/0160). Order Number DE89013391/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

Phosphoric acid, the electrolyte currently in use in acid H_2-O_2 fuel cells, suffers from several limitations. It is desirable to identify new electrodes that have electrochemical and physical properties superior to those of phosphoric acid as faster kinetics for oxygen reduction, higher oxygen solubility and lower anion absorption on the platinum catalyst. Moreover, they should possess high ionic conductivities, low vapor pressures, electrochemical and thermal stabilities and low contact angles with Teflon, characteristics of phosphoric acid. A number of new fluorosulfonic and fluorophosphonic acids have been evaluated as candidates for fuel cell electrolytes. Oxygen reduction data on smooth platinum electrodes indicate that the addition of the new electrolytes to 85% phosphoric acid increases the oxygen solubility in the mixture. Solubility of $(CF_3SO_2)_2CH_2$ n in water is quite good. Aqueous solutions of monosulfonic acids with a terminal SF_5 group such as $SF_5CHFCF_2SO_3H$, are highly soluble in water and show high ionic conductivities, especially at elevated temperatures. The performance of the oxygen cathode of the fuel cell in 85% phosphoric acid containing 1.3% $[HSO_3(CF_2)_2]_2O$ is superior to that of pure phosphoric acid. 34 figs., 1 tab.

33689 (LBL–27025) **Electrochemical evaluation of new fluorosulfonic and fluorophosphonic acids as fuel cell electrolytes: Annual report, January 1, 1988–December 31, 1988.** Saffarian, M.H.; Ross, P.N. Lawrence Berkeley Lab., CA (USA). Dec 1988. 64p. DOE Contract AC03-76SF00098. 5086-260-1229. (GRI–89/0060). Order Number DE89012840/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

The objective of this research program is to evaluate a series of new fluorosulfonic and fluorophosphonic acid as alternative fuel cell electrolytes having superior performance than phosphoric acid. Phosphoric acid, the electrolyte currently in use in acid H_2-O_2 fuel cells, suffers from several limitations. It is desirable to identify new electrolytes that have electrochemical and physical properties superior to those of phosphoric acid such as faster kinetics for oxygen reduction, higher oxygen solubility and lower anion adsorption on the platinum catalyst. Moreover, they should possess high ionic conductivities, low vapor pressures, electrochemical and thermal stabilities and low contact angles with Teflon, characteristics of phosphoric acid. 1 ref., 47 figs.

33690 **A dynamic model of porous gas diffusion electrodes.** Raistrick, I.D. (Los Alamos National Lab., Los Alamos, NM (US)); Springer, T.E. v.v of Proceedings of the Electrochemical Society fall meeting. Volume 88-2 (extended abstracts). The Electrochemical Society, Pennington, NJ (1988). (CONF-881061–: Electrochemical Society fall meeting, Chicago, Illinois, USA, 9-14 Oct 1988).

Although significant attention has been given to steady-state modeling of porous gas diffusion electrodes for fuel cell applications, little development of dynamic models has taken place. This is partly due to the complex nature of the systems, in which the current distribution is a function of both DC potential and time (or frequency). The advantage of a dynamic model, however, is that the information content is very high, due to the out-of-phase or charge-storage components of the response. This allows the different contributions to the electrode polarization (ohmic, mass transport, and charge-transfer kinetics) to be separated by their characteristic time constants. In addition, a dynamic model allows the performance of the fuel cell to be evaluated under pulsed operating conditions. The general scheme adopted in this work may be outlined as follows: 1.

An appropriate physical model of the electrode is defined. 2. The corresponding mathematical model is then developed. 3. The DC or steady-state behavior is calculated from the model. 4. A small-signal time-dependent perturbation analysis is carried out around a steady-state point. 5. The impedance may be compared with frequency- or time-domain measurements, and parameters may be adjusted by a nonlinear least-squared error fitting routine.

33691 Effects of low levels of CO on the performance of pem fuel cells. Gottesfeld, S. (Los Alamos National Lab., MS D429, Los Alamos, NM (US)); Paffett, M.T.; Pafford, J. v.v of Proceedings of the Electrochemical Society fall meeting. Volume 88-2 (extended abstracts). The Electrochemical Society, Pennington, NJ (1988). (CONF-881061–: Electrochemical Society fall meeting, Chicago, Illinois, USA, 9-14 Oct 1988).

CD severely poisons fuel cells operating at low temperatures. For proton-exchange-membrane (PEM) fuel cells, which operate at temperature of 100°C or below, the presence of low levels of CO in the anode feed could means significant losses in cell performance. PEM fuel cells to be employed for potential terrestrial transportation applications and modes of extraterrestrial application are expected to use hydrogen that contains low levels of CO. The authors describe first a detailed evaluation of the performance of PEM fuel cells employing gas-diffusion electrodes of low PT loadings (0.4 mg/cm^2), in the presence of CO levels ranging from 10-1000 ppm. The performance of such cells on clean H_2/O_2, or on H_2/air, has recently been described in detail. The effects of the following parameters have been investigated for each CO level in the anode feed: cell temperature, hydrogen and oxygen (or air) pressure, mode and degree of humidification, and the nature and thickness of the ionomeric membrane. Attention was paid to effects both at the anode and at the cathode. The latter is important because of possible penetration of CO through the membrane reaching the cathode catalyst sites. In another part of this discussion, the authors describe results of single-cell testing obtained with binary alloys that have been considered in the past as anode catalysts with better CO tolerance than Pt. The results of the PEM single-cell testing are complemented by results of experiments with rotating Pt disk electrodes, performed at temperatures ranging between 25°CF - 75°C in dilute sulfuric acid solutions. Such experiments have elucidated key factors in both the transient and steady-state response of a Pt catalyst surface.

33692 Cathodic materials for molten carbonate fuel cells. Smith, J.L. (Argonne National Lab., Argonne, IL (US)); Kucera, G.H.; Minh, N.Q.; Pierce, R.D.; Ackerman, J. v.v of Corrosion '85. National Assoc. of Corrosion Engineers, Houston, TX (1985). (CONF-850311–: National Association of Corrosion Engineers annual meeting and materials performance and corrosion show, Boston, Massachusetts, USA, 25-29 Mar 1985).

A replacement for NiO, the standard cathode material, is being sought due to a dissolution problem. Stable replacement materials have been identified. Work is now underway to understand and modify electronic conductivity mechanisms of these compounds to render them useful as cathode materials. A summary of the problem and the work on the conductivity properties is reported.

33693 An impedance study of the electrodissolution of aluminum in 4M KOH at 25°C. Macdonald, D.D. (SRI International, Menlo Park, CA (US)); Urquidi-Macdonald, M.; Real, S. v.v of Proceedings of the Electrochemical Society fall meeting. Volume 88-2 (extended abstracts). The Electrochemical Society, Pennington, NJ (1988). (CONF-881061–: Electrochemical Society fall meeting, Chicago, Illinois, USA, 9-14 Oct 1988).

An electrochemical impedance analysis of pure aluminum in 4M KOH at 25°C is reported. Impedance spectra have been obtained at 30-80 mV intervals extending from the hydrogen evolution region at -1.96 v (vs. Hg/HgO, 4M KOH) to the transpassive dissolution region at -1.35 V. The impedance spectra are found to consist of two intersecting capacitive semicircles with a loop at intermediate frequencies. The low frequency capacitive arc and the loop become increasingly dominant with respect to the high frequency relaxation as the potential is shifted in the positive direction. The impedance spectra and the steady-state current/voltage characteristics (including the partial anodic and cathodic curves) are accounted for by a model involving the step wise addition of hydroxyl groups to surface aluminum atoms, culminating in the chemical dissolution of $Al(OH)_3$ to form $Al(OH)_4^-$. This anodic process is coupled to hydrogen evolution via competition for bare surface sites. Comparison of the experimental and predicted impedance spectra indicates that the total concentration of reactive sites on the surface varies with potential in a manner that parallel the anodic partial current. This variation is attributed to the existence of a porous corrosion product film on the surface.

33694 Dealloying of Pt alloy fuel cell electrocatalysts. Paffett, M.T. (Los Alamos National Lab., MS D429, Los Alamos, NM (US)); Gottesfeld, S. v.v of Proceedings of the Electrochemical Society fall meeting. Volume 88-2 (extended abstracts). The Electrochemical Society, Pennington, NJ (1988). (CONF-881061–: Electrochemical Society fall meeting, Chicago, Illinois, USA, 9-14 Oct 1988).

Numerous binary and ternary Pt alloys have been investigated as potential anode and cathode electrocatalysts for use in fuel cell devices. Various theories have been suggested to explain the apparent enhancement in specific electrocatalytic reactions occurring at fuel cell electrodes employing these alloy catalysts as compared with Pt-only electrodes with the same specific precious metal loading. Investigations of several of these alloys (e.g., PtCr, PtCo) have demonstrated that a major reason for the apparent enhancement of the electrocatalytic activity towards the oxygen reduction reaction (o.r.r.) is a process of dealloying that can generate a porous metal network of high surface area. With regard to the hydrogen oxidation reaction, the authors have also investigated a bulk alloy (i.e., PtRu) that is reported to possess superior performance, as compared to bulk Pt, in the presence of moderate amounts of CO. In this case, an optimal surface dealloying of the bulk electrode material can produce a surface with both components still present but not with the bulk stoichiometry. At such a surface, significant variation and improvement in the electrocatalytic activity is seen. The authors review in this presentation results of in situ and ex situ analysis of bulk alloy samples undergoing dealloying under potential electrochemical conditions encountered in a fuel cell application. They describe the net effect that this dealloying can have on the intended electrocatalytic reaction.

33695 Measurement of passive film growth kinetics on bare surface niobium band microelectrodes. Davenport, A.J. (Dept. of Applied Science, Brookhaven National Lab., Upton, NY (US)); Isaacs, H.S. v.v of Proceedings of the Electrochemical Society fall meeting. Volume 88-2 (extended abstracts). The Electrochemical Society, Pennington, NJ (1988). (CONF-881061–: Electrochemical Society fall meeting, Chicago, Illinois, USA, 9-14 Oct 1988).

Microelectrodes have a number of advantages over electrodes of conventional size. These include a reduction in ohmic (IR) drop in the solution and an increase in mass transport rates to and from the electrode surface. As a result, microelectrodes have been increasingly used in areas such as high speed cyclic voltammetry and in corrosion studies. In this study, a film of niobium ~4000 A thick was sputtered on to a glass cover slide and second glass cover slide was stuck to the surface of the film with an epoxy adhesive leading one end of the film exposed to allow electrical connection. In order to prepare the composite for fracture, both the top and bottom glass slides were scored directly opposite each other, with a diamond stylus. The scored part of the electrode was immersed in the solution and placed under potentiostatic control. The composite was then fractured along the scored lines by impact, exposing a bare metal band microelectrode ~2 cm in length and a width equal to the thickness of the sputtered film (√4000 A). The bare surface oxidizes rapidly: the resulting current transient was captured on a high speed transient digitizer.

33696 Effect of diffusion layer structure on the determination of corrosion rates from DC transient measurements. Nagy, Z. (Argonne National Lab., Divs. of Materials Science, Chemical Technology, and Mathematics and Computer Science, Argonne, IL (US)); Hernes, P.J.; Minkoff, M.; Leaf, G.K.; Land, R.H. v.v of Proceedings of the Electrochemical Society fall meeting. Volume 88-2 (extended abstracts). The Electrochemical Society, Pennington, NJ (1988). (CONF-881061–: Electrochemical Society fall meeting, Chicago, Illinois, USA, 9-14 Oct 1988).

The initial condition states that, before the application of the measuring pulse, the concentration of all species at the electrode

surface is the same as their bulk concentration (C_j). The first boundary condition states that at a certain distance from the electrode surface (δ) the concentration of all species remains equal to the bulk concentrations at all times. This distance is usually considered to be so large that for all practical considerations it is infinity. The second boundary conditions expresses the equivalence of the rate of the surface reactions (expressed as the Faradaic current density) and the diffusion fluxes. These conditions are correct for a typical redox reaction of $O + ne = R$. In the investigation of this reaction, the measurement starts from equilibrium, where the oxidation of R and the reduction of O occur at the same rate: therefore, no net current is flowing and no net chemical change is taking place before the application of the measuring pulse. Furthermore, the measurement is being carried out in such a short time scale that convection does not interfere with the diffusional mass transport, and δ can, indeed, be set to infinity. The situation is completely different for a corroding electrode because a corroding metal is not in equilibrium, only in a steady state. Two distinctly different partial reactions, the dissolution of the metal ($M \omega M^{n+}$ - ne) and the reduction of a component of the environment (e.g., $2H^+ + 2e \rightarrow H_2$), occur at the same rate. (It is usually assumed that the rates of the reverse reactions are negligible.) Under these conditions, while there is not net current flowing through the system, there is a net chemical change taking place: the corrosion of the metal. Therefore, there must be a continuous flux of reactants to, and a flux of products away from the surface.

33697 Studies on hydrogen-permeable nickel membrane fuel cell. Lu, S.H. (Institute of Gas Technology, 3424 South State Street, Chicago, IL (US)); Remick, R. v.v of Proceedings of the Electrochemical Society Fall meeting: Extended abstracts. Volume 87-2. The Electrochemical Society, Pennington, NJ (1987). (CONF-871027–: 172. meeting of the Electrochemical Society, Honolulu, Hawaii, USA, 18-23 Oct 1987).

At the present time, molten carbonate fuel cell (MCFC) technology stands on the threshold between laboratory demonstration and development of full-scale systems. However, several issues need to be resolved before development of full-scale systems can be undertaken. The major concern of these issues is the endurance of fuel cells. Although prototype molten carbonate fuel cell stacks have been demonstrated for up to 5000 hours, a minimum lifetime of 25,000 hours is necessary for economic operation of full-scale systems. Most of those issues are generic to the design of the fuel cells and the use of nickel as porous electrodes at the anode and the cathode (NiO) as well. The following are considered to be major issues limiting long-term endurance: (1) Contamination of molten electrolyte by the fuel gas containing low levels of sulfides and chlorides. (2) Deactivation of internal reforming catalysts by molten carbonate. (3) Creep and deformation of porous anode structure. (4) Dissolution of lithiated nickel oxide cathode. (5) Corrosion of separator plates. (6) Loss of electrolyte through evaporation and migration. Most of these problems can be mitigated or eliminated by changing the configuration of the fuel cell. It has been known for some time that it should be possible to operate a fuel cell using a solid nickel membrane as anode structure. This anode structure is permeable to hydrogen but impermeable to other gases and electrolyte; therefore, it works as a barrier which prevents carbonate from reaching the hardware on the anode side and also prevents contaminants from reaching the electrolyte.

33698 A novel adaptation of the finite difference method for accurate description of non-orthogonal boundaries. Lynes, W.M. (Dept. of Chemical Engineering, Case Western Reserve Univ., Cleveland, OH (US)); Landau, U. v.v of Proceedings of the Electrochemical Society fall meeting. Volume 88-2 (extended abstracts). The Electrochemical Society, Pennington, NJ (1988). (CONF-881061–: Electrochemical Society fall meeting, Chicago, Illinois, USA, 9-14 Oct 1988).

Modeling of current and potential distribution in electrochemical cells require solving Laplace's equation for the potentials. This can be achieved in a general geometry cell by a number of numerical techniques including finite difference, finite element, boundary integral, and orthogonal collocation. The finite difference method is particularly attractive because of its speed, simplicity, and robustness. Its main difficulty, however, lies in accurately describing non-orthogonal boundaries (i.e., corners that are not right angles). Described here is a novel extension of the finite difference technique which enables accurate description of such boundaries. The method has been applied to modeling current and potential distributions in general geometry (2-D) electrochemical cells and implemented on various personal computers. Comparison with other numerical techniques has been quite favorable. The basic concept embodied in the finite difference method is a current balance solved at each point in the grid. The new technique is based on conducting current balances on these non-rectangular elements. A potential gradient is assigned to each face of the non-rectangular elements. The current contributions associated with each of these are carefully added and interfaced with the boundary conditions. The potential assigned to a sloping electrode element is determined by extrapolation of the grid point potentials.

33699 Stability analysis of metal electrodeposition. Barkey, D.P. (Dept. of Chemical Engineering, Univ. of California, Berkeley, CA (US)); Muller, R.H.; Tobias, C.W. v.v of Proceedings of the Electrochemical Society fall meeting. Volume 88-2 (extended abstracts). The Electrochemical Society, Pennington, NJ (1988). (CONF-881061–: Electrochemical Society fall meeting, Chicago, Illinois, USA, 9-14 Oct 1988).

A stability analysis of metal electrodeposition on a smooth surface has been formulated and applied to copper deposition on a rotating cylinder. The analysis is an extension of Landau's treatment to include the electric field explicitly. Current distribution on a sinusoidal profile was found by a first order perturbation technique accounting for ohmic, kinetic and concentration overpotentials, and the derived current distribution was used to evaluate the rate of growth or decay of the perturbation. In agreement with Landau's result, deposition was found to be unstable for all practical conditions. The only stabilizing influence, the surface free energy, is insignificant for features larger than one micrometer. The rate of surface amplification is, however, sensitive to electrolysis parameters that can be controlled, and the analysis therefore provides useful information on conditions favorable to the production for coherent deposits and on expected protrusion spacing.

33700 A study of oxygen reduction in gas diffusion electrodes for an electrochemical concentrator. Waterhouse, R. (Physical Sciences Inc., Research Park, P.O. Box 3100, Andover, MA (US)); Taylor, E.J. v.v of Proceedings of the 1987 Electrochemical Society spring meeting: Extended abstracts. Volume 87-1. The Electrochemical Society, Pennington, NJ (1987). (CONF-870560–: 171. Electrochemical Society meeting, Philadelphia, Pennsylvania, USA, 10-15 May 1987).

The authors are currently developing an electrochemical concentrator for use in chlorine-caustic plants to increase the concentration of the sodium hydroxide product of membrane electrolyzers from 30 weight percent NaOH to 50 weight percent for commercial use. Presently excess water is removed in evaporators fueled by hydrogen derived from the brine electrolysis, plus extra fossil fuel. The electrochemical concentrator performs the same task, with the coproduction of electrical power, by using an alkaline fuel cell with a cation-selective membrane separator. The 30 weight percent sodium hydroxide solution from the electrolyzer is split into two streams that become the electrolyte for the fuel cell, one stream on the anode side and one on the cathode side of the separator. Oxygen is reduced at the cathode, forming hydroxide, and hydrogen is oxidized at the anode, forming water, while the sodium ions migrate through the membrane from the anode side to the cathode side. Additional water is removed from the cathode side by evaporation into the air stream. Thus the sodium hydroxide becomes concentrated at the cathode and diluted at the anode.

33701 $ZnCl_2$-HCl plating baths for stripping and recovery of zinc from galvanized iron scrap. Zaromb, S. (Argonne National Lab., Argonne, IL (US)); Fraioli, A.V.; Daniels, E.J.; Queen, G.V.; Bozen, R.M. v.v of Proceedings of the Electrochemical Society fall meeting. Volume 88-2 (extended abstracts). The Electrochemical Society, Pennington, NJ (1988). (CONF-881061–: Electrochemical Society fall meeting, Chicago, Illinois, USA, 9-14 Oct 1988).

To recover zinc and remove zinc contaminants from reprocessable galvanized iron scrap, several acid plating baths were evaluated. For a fast process throughput, all tests were performed

at current densities 90 mA/cm^2 and at ambient temperature (20-25^{0}C). The following problems were initially encountered: 1. Formation of zinc dendrites at the cathode; 2. Absence of a marker that would indicate complete removal of zinc from the anode; and 3. Excessive electrolyte resistivity, causing an unacceptable voltage drop between the cathode and anode. To minimize dendrite formation, stirring of the electrolyte and electrochemical precleaning of the electrodes (by passing a 10-sec reverse pulse at the start of each run) became part of the experimental protocol. Next, the plating bath composition was varied in attempts to obtain a marker that would indicate the nearly complete removal of zinc from the exposed anode surface. Raising the pH from about 4.0 to 5.7 or reducing it, first to pH 1.4 and subsequently to pH 0.4, did not yield a clearcut marker. Neither did inclusion of $K_3Fe(CN)_6$ (which was expected to yield a passivating deposit on an exposed iron surface) or the use of various sulfate-containing baths. However, sulfate-free zinc chloride baths did yield indications of a possible marker even at a pH of 3.8, and these indications became more pronounced as the HCl concentration was increased, first to 1 M and subsequently to 1.5-4 M. At the higher HCl concentrations, a marker would be consistently observed at all but the highest ($\geq$630 mA/cm^2) current densities.

33702 Fuel cells for extraterrestrial and terrestrial applications. Srinivasan, S. (Los Alamos National Lab., Los Alamos, NM (US)). v.v of Proceedings of the 1987 Electrochemical Society spring meeting: Extended abstracts. Volume 87-1. The Electrochemical Society, Pennington, NJ (1987). (CONF-870560–: 171. Electrochemical Society meeting, Philadelphia, Pennsylvania, USA, 10-15 May 1987).

The main advantage of hydrogen/oxygen fuel cell systems for space applications are high power and energy density with respect to weight and volume, high efficiency, few moving parts, minimum noise and vibration, and high reliability. The Gemini space flights used a General Electric solid polymer electrolyte fuel cell (1kW). It performed quite well for the missions of duration about 1-2 weeks. Though it satisfied the performance requirements for such flights, there were some problems with this technology. The power densities attained were not high enough. The polystyrene sulfonate ion exchange membrane electrolyte was not stable under the electrochemical environments in the cell. The platinum loading was quite high. Thus, the alkaline fuel cell technology was chosen for the Apollo and space shuttle flights. The Pratt and Whitney Division of United Technologies, Corporation developed the alkaline fuel cell systems for the Apollo flights - these fuel cells used the Bacon fuel cell technology with dual porosity nickel electrodes. These fuel cell systems (about 2 kW) performed quite satisfactorily for missions which lasted 2-4 weeks. For the space shuttle flights of the 1970's and 1980's, United Technologies Corporation/International Fuel Cells Corporation, developed a high performance alkaline fuel cell system (12 kW), with platinum anodes, and gold (90%) - platinum (10%) cathodes.

33703 Analysis and interpretation of ac impedance data for porous electrodes. Raistrick, I.D. (Los Alamos National Lab., Los Alamos, NM (US)); Springer, T.E. v.v of Proceedings of the 1987 Electrochemical Society spring meeting: Extended abstracts. Volume 87-1. The Electrochemical Society, Pennington, NJ (1987). (CONF-870560–: 171. Electrochemical Society meeting, Philadelphia, Pennsylvania, USA, 10-15 May 1987).

In principle, the small signal dynamic response of a porous electrode contains significantly more information about the electrode than does the more usually considered steady-state or DC response. Ideally, we would like to use this information to assess the influence of design and processing variables on the performance of fuel cell electrodes. The main difficulty, of course, lies in defining models that describe the dynamic response of a porous electrode in a useful way, and then extracting model parameters by fitting to experimental data. In this paper small-signal AC data obtained from porous gas-fed oxygen electrodes are fitted to some simple distributed circuits using a non-linear least squares procedure, and the validity of the models and procedures is discussed.

33704 Reference electrodes/sensors using low-resistivity glass membranes. Bloom, I. (Chemical Technology Div., Argonne National Lab., Argonne, IL (US)); Heiberger, J.J.; Internoscia, M.A.; Rea, K.; Redey, L. v.v of Proceedings of the Electrochemical Society fall meeting. Volume 88-2 (extended abstracts). The Electrochemical Society, Pennington, NJ (1988). (CONF-881061–: Electrochemical Society fall meeting, Chicago, Illinois, USA, 9-14 Oct 1988).

Development of miniature reference electrode systems to measure either sodium or sodium polysulfide activity has continued. The reference electrodes contain small (2-mm^2 active area), thin membranes of a Na^+-ion-conducting glass which was developed as part of the authors' work on glass electrolytes for the Na/S cell. The small, electrochemically active area of the reference electrode makes precise positioning possible in an electrochemical system of interest. The reference electrode is made by attaching a thin membrane of glass to a narrow, (ca. 3-mm OD), high-density α-Al_2O_3 tube. Once a reference material is sealed within it, the small active area behaves like a luggin capillary tip. It was necessary to demonstrate the thermal and operational limits of the glass. That is, it was not known if glasses in the Na_2O-ZrO_2-Al_2O_3-SiO_2 system have sufficient chemical stability in a harsh environment, such as Na at high temperatures, to provide meaningful data. A reference electrode containing Na_2S_2 was tested in Na at about 600^{0}C to determine the chemical stability of the glass as well as the stability of the EMF. After equilibration, at 586^{0}C, a stable EMF ($\pm$2 mV) of 1.488 V was measured for 11 hours. Thereafter, a sharp decrease in EMF was observed. This decrease was due to electrode failure.

33705 Mixed-conducting membranes for hydrogen-transporting S/L/S solid electrolyte configurations. Schreiber, M. (Dept. of Materials Science and Engineering, Stanford Univ., Stanford, CA (US)); Wolfenstine, J.; Huggins, R.A. v.v of Proceedings of the Electrochemical Society fall meeting. Volume 88-2 (extended abstracts). The Electrochemical Society, Pennington, NJ (1988). (CONF-881061–: Electrochemical Society fall meeting, Chicago, Illinois, USA, 9-14 Oct 1988).

A novel S/L/S configuration that can be used as a solid electrolyte for hydrogen at elevated temperatures was recently described. It consists of two solid, but hydrogen - transparent, metallic membranes that act as mixed - conducting electrodes. Between these membranes is a molten salt containing hydride ions. One example is a solution of LiCl, HCl, and LiH. Such salts are stable at temperatures appreciably higher than proton - containing salts. By placing a potential difference between the two mixed conductors, hydrogen is caused to move across the electrolyte. If the chemical diffusion of hydrogen is sufficiently fast within the membrane electrodes, the difference in hydrogen activity imposed by the potential difference will appear on their outer surfaces. Alternatively, rapid chemical diffusion of hydrogen through such membranes means that the imposition of a chemical potential difference at their outer surfaces is translated into a difference in chemical potential between their inner surfaces, and thus across the electrolyte, producing a difference in the electrochemical potential of electrons, and thus a measurable voltage. Thus such a configuration can be used in either pump or a sensor modes, operating in a manner directly analogous to a solid electrolyte with porous three - phase - contact electrodes in contact with gases.

33706 Application of ion implantation to the study of electrocatalysis. Kelly, E.J. (Chemistry Div., Oak Ridge National Lab., Oak Ridge, TN (US)); Heatherly, D.E.; Vallet, C.E.; White, C.W. v.v of Proceedings of the Electrochemical Society Fall meeting: Extended abstracts. Volume 87-2. The Electrochemical Society, Pennington, NJ (1987). (CONF-871027–: 172. meeting of the Electrochemical Society, Honolulu, Hawaii, USA, 18-23 Oct 1987).

The intent of the research described herein was to demonstrate the value of nonequilibrium surface-modification techniques (ion implantation, ion-beam mixing, etc.) for the generation and systematic study of electrocatalytically active surfaces. For this purpose, a detailed study was made of the electrocatalysis of chlorine evolution (and, to a lesser extent, oxygen evolution) at Ru-implanted titanium electrodes in aqueous media. Ru-implanted titanium near-surface alloys were generated by ion implantation of ^{102}Ru ions into zone-refined titanium, and characterized (Ru concentration/depth profiles) by Rutherford backscattering. A judicious selection of multiple beam energies (40, 70, and 120 keV) and fluences (number of ions implanted per cm^2 of surface) at each energy enabled the generation of near-Gaussian profiles extending over a depth of approximately 100 nm and having a rather broad Ru concentration peak located at

20-40 nm from the surface. The peak Ru concentrations ranged from 1.94×10^{21} to 1.77×10^{22} atoms cm^{-3}.

3008 Miscellaneous Converters

33707 Acoustic wave electroless deposition monitor. Ricco, A.J. (Sandia National Labs., Albuquerque, NM (US)); Martin, S.J. v.v of Proceedings of the Electrochemical Society Fall meeting: Extended abstracts. Volume 87-2. The Electrochemical Society, Pennington, NJ (1987). (CONF-871027–: 172. meeting of the Electrochemical Society, Honolulu, Hawaii, USA, 18-23 Oct 1987).

A new type of electroless deposition monitor has been constructed from a planar, monolithic acoustic wave device utilizing plate modes with surface shear displacement components. This device, which operates at 158 MHz, provides a highly accurate means of measuring mass changes (10 ng/cm^2 or better) accompanying electrochemical reactions. The acoustic wave is launched by applying a radio frequency signal to an interdigital transducer on the surface of a piezoelectric substrate. Electroless deposition is carried out on the quartz surface in the path of the wave. A small bottom less cell contains the deposition solution. The acoustic wave propagates beneath the cell and along the surface/electrolyte interface to the receiving transducer. Changes in mechanical properties, electrical conductivity, and mass at the quartz/electrolyte interface affect the acoustic wave velocity, which is monitored with high accuracy. Electroless deposition of copper from a Cu^{2+}/formaldehyde solution was examined as a demonstration.

33708 The dependence of bulk piezoelectric crystal resonance behavior on fluid properties. Sigalla, L. (Dept. of Chemical Engineering, Univ. of Washington, Seattle, WA (US)); Hager, H.; Kowalski, B.; Simpson, R. v.v of Proceedings of the Electrochemical Society fall meeting. Volume 88-2 (extended abstracts). The Electrochemical Society, Pennington, NJ (1988). (CONF-881061–: Electrochemical Society fall meeting, Chicago, Illinois, USA, 9-14 Oct 1988).

Piezoelectric crystal-based sensors have been used routinely in vacuum systems for measuring film deposition thicknesses. In these application, mass added to the crystal surface linearly decreases the crystal resonant frequency; this frequency is used as a simple direct measure of mass deposition. In application of bulk piezoelectric crystal sensors to liquid phase analysis, the resonant behavior of the crystal depends on both adherent mass changes on the crystal and coupling processes between the crystal and fluid. The potential then exists to use the piezoelectric crystal as a monitor for all of the fluid parameters which influence this coupling. Thus piezoelectric crystal based sensors offer promise for simultaneously sensing some or all of the following fluid properties: viscosity, density, specific conductivity, and dielectric constant. These fluid parameters also need to be accounted for when piezoelectric crystal-based sensors are used for mass measurements, e.g., corrosion, electrodeposition and adsorption, for determination of fluid flow rates, and for evaluation of surface properties, such as surface tension and surface roughness.

32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

Refer also to citation(s) 33658

33709 (DOE/EIA–0526) **Estimates of short-term petroleum fuel switching capability.** USDOE Energy Information Administration, Washington, DC (USA). Office of Energy Markets and End Use. May 1989. 45p. Sponsored by DOE Management & Administration. Order Number DE89013477/JAW. Available from NTIS, PC A03/MF A01 - GPO - OSTI; GPO Dep.

This report provides estimates of the capability of individual economic sectors to switch from petroleum fuels to other fuels or energy sources in the short term in 1989. This information is necessary for ongoing emergency planning related to disruptions in the supply of oil. The term "fuel switching" in the context of this report refers to the potential for replacing petroleum fuels with non-petroleum fuels or energy sources, (1) by companies or households with a current capability to consume multiple fuels, (2) in a manner that will not require significant investment in plant and equipment, and, (3) in a manner that will not alter total energy end-use consumption. In accordance with this definition, long-term switching potential, requiring new plant and equipment, is not examined. Only estimates of short-term switching potential (within 30 days or 6 months) are provided, because these are more significant for emergency planning. 21 refs., 18 tabs.

33710 (LBL–25716) **Energy efficiency and structural change: Implications for the greenhouse problem.** Meyers, S. (ed.). Lawrence Berkeley Lab., CA (USA). Aug 1988. 65p. Sponsored by Environmental Protection Agency. DOE Contract AC03-76SF00098. (CONF-8805294–Summs.: Workshop on energy efficiency and structural change: implications for the greenhouse problem, Oakland, California, USA, 1-3 May 1988). Order Number DE89012852/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

The "Workshop on Energy Efficiency and Structural Change: Implications for the Greenhouse Problem" was part of a major study of global change and options for mitigating such change being conducted by the US Environmental Protection Agency (EPA). It was one of four workshops sponsored by EPA on various topics important to analysis of the greenhouse problem. The purpose of this workshop, which was organized and co-sponsored by Lawrence Berkeley Laboratory, was to provide a forum for experts from a variety of backgrounds to share information and ideas about the long-run prospects for energy efficiency and the effect on energy demand of structural economic and demographic changes. The information presented and discussed at the workshop is being used by the EPA in refining scenarios of long-range energy consumption and the climatic implications of different levels of energy use, and in its examination of the impact of policy options that might be available to the global community to limit emissions of atmospheric gases that contribute to global climate change. EPA has been requested to provide this analysis by the US Congress.

3201 Buildings

Refer also to citation(s) 33190, 33191, 33412, 33421, 33451, 33638, 33653, 33654, 33655, 33672, 33675, 33676, 34029, 34170

33711 (BFR-R–3-1987) **Energy saving by equipment based upon microcomputers. Comparison between computerized and time control of a ventilation a heating system.** Joensson, O. Swedish Council for Building Research, Stockholm (Sweden). 1987. 45p. (In Swedish). Order Number DE89776223/JAW. Available from NTIS (US Sales Only), PC A03/MF A01;1.

Many industries are buying most of their heating energy. In order to save energy many devices are produced for this purpose. One of these items is a micro computerized control element. This element is able to collect and process data from different transmitters in a system and to optimize the necessary amount of heating energy for each individual case. A control function of such a system is an advanced programmable real time controller. The question is: How much of saved energy is the result of the real time control and the computer, respectively? In order to get an answer to these questions an investigation has been performed in a representative building. The investigation shows that the energy use not necessarily is reduced if real time control is replaced by microcomputerized control but may even be increased if consideration is not taken upon the influence of ventilation and heating systems. (L.F.).

33712 (BFR-R–48-1988) **Advanced heat pump for single-family dwellings. Market potential in Sweden, Norway, USA, and Canada.** Wiren, M. Swedish Council for Building Research, Stockholm (Sweden). 1988. 50p. (In Swedish). Order Number DE89776230/JAW. Available from NTIS (US Sales Only), PC A03/MF A01;1.

The objective of this project has been to produce a marketing and technical basis for a decision on whether to develop a new type of heat pump intended particularly for use in electrically heated detached houses. The market analysis that was performed involved investigation of the building stock and heating markets in Sweden, Norway, Canada, the USA, Denmark, France and the Federal Republic of Germany. A more comprehensive analysis, using simulation modelling, will be performed for the Swedish market. The

results are presented in the form of easily-comprehended tables with brief comments and analyses, together with recommendations and conclusions relating to the market development potential for Swedish heat pumps.

33713 (BFR-R–82-1988) **Short-term heat storage in excavated wells in earth. A feasibility study.** Bogdanoff, I. Swedish Council for Building Research, Stockholm (Sweden). 1988. 51p. (In Swedish). Order Number DE89776231/JAW. Available from NTIS (US Sales Only), PC A04/MF A01;1.

The objective of this work has been to investigate short-term storage of heat in wells sunk into clay. Thermal insulation is provided only around the top of the well. Heat losses amount to about 14% after some days, and the transient heating process involved in 24-hour storage affects only about 0.2 m of the earth around the well. Macadam and/or water can be used as the heat storage medium. If the wells are filled with stone, they can also serve as foundation elements. The upper surface of the store can be used, even if the store is filled with water. The costs of water-filled well are of the same order as those for a small industrial storage tank for heat storage. The report describes several problem areas that may be relevant for others types of heat stores in earth.

33714 (BFR-R–98-1988) **Air heat pumps in the residential sector. Low-frequency acoustic nuisance.** Benjegaard, S.O.; Lidberg, K. Swedish Council for Building Research, Stockholm (Sweden). 1988. 44p. (In Swedish). Order Number DE89776233/JAW. Available from NTIS (US Sales Only), PC A03/MF A01;1.

The objective of this work has been primarily to identify the causes of unexpected low-frequency noise from an air heat pump at Brunnsberg in Varberg, and secondarily to indicate suitable countermeasures for new air heat pumps intended to reduce the level of low-frequency noise. The results indicate the probable reasons for the problems in Brunnsberg, and the report also makes certain recommendations concerning selection and installation of the fan or fans and points out the danger of building designs having resonant frequencies in the range where the fan can generate problem frequencies. (authors).

33715 (BFR-R–107-1988) **Degradation of glycols in heat pumps and solar heating systems. Laboratory investigation.** Cedheim, L.; Blume, U.; Lundgren, B. Swedish Council for Building Research, Stockholm (Sweden). 1988. 36p. (In Swedish). Order Number DE89776237/JAW. Available from NTIS (US Sales Only), PC A03/MF A01;1.

The objective of this project has been to investigate how quickly glycols break down in glycol/water mixtures under accelerated ageing conditions (elevated temperature) in the presence of the metals most commonly encountered in heat pumps and solar heating systems and in the presence of some common inhibitor systems. The main aim has been to identify the corrosive degradation products formed by/from the various glycols. Laboratory trials have confirmed that it is mainly glycolic acid that is formed from ethylene glycol, while lactic acid, formic acid and acetic acid tend to be the main degradation products from propylene glycol, depending on conditions. The work has shown clearly that the decomposition of glycols is a complicated process, and that the results cannot easily be explained. The process seems to be highly dependent on temperature and the type of additives intended to prevent corrosion of the metals in the system. (authors).

33716 (CONF-890609–4) **Refrigerator-freezer energy testing with alternative refrigerants.** Vineyard, E.A.; Sand, J.R.; Miller, W.A. Oak Ridge National Lab., TN (USA). 1989. 14p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. From ASHRAE annual meeting; Vancouver, Canada; 24-28 Jun 1989. Order Number DE89013543/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

As a result of the Montreal Protocol that limits the production of ozone-depleting refrigerants, manufacturers are searching for alternatives to replace the R12 that is presently used in residential refrigerator-freezers. Before an alternative can be selected, several issues must be resolved. Among these are energy impacts, system compatibility, cost, and availability. In an effort to determine the energy impacts of some of the alternatives, energy consumption tests were performed in accordance with section 8 of the Association of Home Appliance Manufacturers (AHAM) standard for household refrigerators and household freezers. The results are presented for an 18 cubic foot (0.51 cubic meter), top-mount refrigerator-freezer with a static condenser using the following refrigerants: R12, R500, R12/Dimethyl-ether (DME), R22/R142b, and R134a. Conclusions from the AHAM test are that R500 and R12 /DME have a reduced energy consumption relative to R12 when replaced in the test unit with no modifications to the refrigeration system. Run times were slightly lower than R12 for both refrigerants indicating a higher capacity. While the R134a and R22/R142b results were less promising refrigeration system, such as a different capillary tube or compressor, may improve their performance. 12 refs., 2 figs., 3 tabs.

33717 (DOE/BP–1212) **The commercial audit database: A descriptive data summary: Volume 1, Methodology and findings.** USDOE Bonneville Power Administration, Portland, OR (USA). Office of Energy Resources. Mar 1989. 99p. Sponsored by DOE Management & Administration. Order Number DE89013097/JAW. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

Data collected during energy use audits of 3900 commercial buildings on more than 3800 sites in the Pacific Northwest were stored, concurrently with data collection, in a computerized database. The database thus built contained 266 variables, 72 of which were inappropriate for public distribution for reasons ranging confidentially (for example, contract numbers and business addresses) to triviality (for example, dates when forms were received from contractors). This report displays and describes the information obtained from 3714 single-building sites in terms of three datasets derived from the raw data. Volume 1 discusses the methodologies of data improvement, describes the structure of the Commercial Audit Database and the report, and provides summary displays and descriptions of 48 selected variables. Volume 2 is a set of appendices that includes summary displays of the 194 variables from the primary dataset and from a dataset containing 287 checked and verified records. 3 refs., 4 figs, 3 tabs.

33718 (DOE/BP/12921–4-Vol.1) **Indoor air quality in commercial buildings: Volume 1, Measurement results and interpretation: Final report, December 1987.** Turk, B.H.; Brown, J.T.; Geisling-Sobotka, K.; Froehlich, D.A.; Grimsrud, D.T.; Harrison, J.; Koonce, J.F.; Prill, R.J.; Revzan, K.L. USDOE Bonneville Power Administration, Portland, OR (USA); Lawrence Berkeley Lab., CA (USA). Apr 1989. 147p. Sponsored by DOE/CE;DOE/ER. DOE Contract AI79-83BP12921;AC03-76SF00098. Order Number DE89013031/JAW. Available from NTIS, PC A07/MF A01 - OSTI; GPO Dep.

Through their involvement in energy conservation programs, the Bonneville Power Administration (BPA) may make recommendations leading to reductions in ventilation rates in commercial and institutional buildings. The effects of these recommendations on indoor air quality were uncertain. Because of these uncertainties BPA initiated the survey of ventilation rates and pollutant concentration in the stock of existing Pacific Northwest buildings described in this report. Specific study objectives included: (1) To provide baseline information about pollutant concentrations and ventilation rates in a sample of the existing building stock. This sample should reflect conditions in large, mechanically-ventilated buildings. (2) If possible, to demonstrate relationships between indoor air pollutant levels and ventilation rates. Thirty-eight buildings were monitored, each for a two-week period (two buildings at two separate times). Pollutants sampled included radon (Rn), formaldehyde (HCHO), respirable suspended particles (RSP), polycyclic aromatic hydrocarbons (PAH), nitrogen dioxide (NO_2), carbon monoxide (CO), carbon dioxide (CO_2), and water vapor (H_2O). This study did not measure/evaluate volatile organic compounds (other than formaldehyde) or microbiological pollutants. Average ventilation rates were measured using tracer decay techniques. 4 refs., 46 figs., 30 tabs.

33719 (DOE/BP/12921–5-Vol.2-App.) **Indoor air quality in commercial buildings: Volume 2, Appendices: Final report, December 1987.** Turk, B.H.; Brown, J.T.; Geisling-Sobotka, K.; Froehlich, D.A.; Grimsrud, D.T.; Harrison, J.; Koonce, J.F.; Prill, R.J.; Revzan, K.L. USDOE Bonneville Power Administration, Portland, OR (USA); Lawrence Berkeley Lab., CA (USA). Apr 1989.

68p. Sponsored by DOE/CE;DOE/ER. DOE Contract AI79-83BP12921;AC03-76SF00098. Order Number DE89013032/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

Through their involvement in energy conservation programs, the Bonneville Power Administration (BPA) may make recommendations leading to reductions in ventilation rates in commercial and institutional buildings. The effects of these recommendations on indoor air quality were uncertain. Because of these uncertainties BPA initiated the survey of ventilation rates and pollutant concentrations in the stock of existing Pacific Northwest buildings described in this report. Specific study objectives included: (1) To provide baseline information about pollutant concentrations and ventilation rates in sample of the existing building stock. This sample should reflect conditions in large, mechanically-ventilated buildings. (2) If possible, to demonstrate relationships between indoor air pollutant levels and ventilation rates. Thirty-eight buildings were monitored, each for a two-week period (two buildings at two separate times). Pollutants sampled included radon (Rn), formaldehyde (HCHO), respirable suspended particles (RSP), polycyclic aromatic hydrocarbons (PAH), nitrogen dioxide (NO_2), carbon monoxide (CO), carbon dioxide (CO_2), and water vapor (H_2O). This study did not measure/evaluate volatile organic compounds (other than formaldehyde) or microbiological pollutants. Average ventilation rates were measured using tracer decay techniques. Volume 2 contains 14 appendices.

33720 (DOE/BP/60288–3) **Market study of commercial appliances: Volume 2, Replacement market for heating, ventilation and air conditioning and water heating equipment: Final report.** ADM Associates, Inc., Sacramento, CA (USA). Mar 1989. 203p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract AC79-86BP60288. Order Number DE89013094/JAW. Available from NTIS, PC A10/MF A01 - OSTI; GPO Dep.

With the slowing of new construction and with buildings built in the 1960s and 1970s now undergoing renovation and upgrading, the replacement of HVAC and water heating equipment is becoming an increasingly larger proportion of the market for heating, ventilation, and air conditioning (HVAC) equipment. This growing market also offers an opportunity for improving the efficiency with which energy is used if more efficient equipment can be installed to replace the old equipment. Compared to the attention that has been given to encouraging energy conservation in the design and construction of new commercial buildings, relatively little is currently known about the factors affecting the replacement of HVAC and water heating equipment in commercial buildings. The major thrust if the work reported here, therefore, has been to identify sources of information on the factors that are important in affecting replacement decisions, using this information to analyze the replacement market for HVAC and water heating equipment and identifying major considerations involved in developing a marketing program to encourage the installation of more efficient units when replacement occurs. 7 refs., 2 figs., 21 tabs.

33721 (DOE/BP/64355–1) **Prediction of moisture movement in the walls of residences.** Spolek, G.A.; Oosterhout, G.R. Portland State Univ., OR (USA). May 1989. 36p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract AI79-86BP64355. Order Number DE89013077/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

More energy-efficient buildings are being constructed today. This trend has increased concern about the presence of moisture in wall cavities as buildings become "tighter." Moisture problems include obvious symptoms such as peeling paint and mildew, as well as less apparent symptoms such as degradation of insulation performance and damage to structural members from dry rot. This study aimed to develop a model to examine the potential for moisture accumulation in common residential construction exposed to typical Northwest climates. The report focuses first on a description of the analysis involved in heat and moisture transport through multilayered walls, and then on a mathematical description of the physical model. The mathematical model incorporates latent heat effects and time-varying external conditions. Simplifying assumptions are made in order to allow a numerical solution of the governing differential equations. 31 refs., 12 figs., 2 tabs.

33722 (IKE–4-124) **Expert system for selection and evaluation of heating system improvement measures.** Sachs, S. Stuttgart Univ. (Germany, F.R.). Inst. fuer Kernenergetik und Energiesysteme. Jul 1986. 128p. (In German). Order Number DE89783022/JAW. Available from NTIS (US Sales Only), PC A07;3.

This work describes the development of a knowledge based system for the goal oriented generation and evaluation of feasible actions. The system is applied to the selection and evaluation of energy saving investments in the field of building maintainance. The methods developed are tested by comparisons with known results. The tests show adequacy for a first approach but also shortcomings for a detailed evaluation of costs and benefits due to the limited accuracy of global saving factors. Further samples show the capabilities of the system.

33723 (ITL–8509, pp. 208-212) **Soil air as a heat source for domestic heating by heat pumps.** Andersson, S. (AIB Consulting Engineers, Solna, Sweden); Eriksson, A; Schmied, H. Intertask Ltd., Ottawa, ON (Canada). 1985. (In English and French). (CONF-850905–: ENERSTOCK '85 - international conference on energy storage for building heating and cooling, Toronto, Canada, 22-26 Sep 1985;MICROLOG–89-00267). In *Enerstock 85. 3rd International conference on energy storage for building heating and cooling. Proceedings.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, Canada K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

To reduce peak demands of electricity for outdoor-air heat pumps, soil air as a heat source for heat pumps has been studied. In some areas of Sweden, large volumes of gravel and sand with ground water levels below 5-15 m from land surface offer possibilities to extract soil air from shallow wells. The soil air has a temperature corresponding to groundwater temperature or to the yearly mean air-temperature for the place in question. A practical test with an air well (diameter 1 m, depth 4 m) in an esker has shown that air can be extracted at a flow rate of 0.23 m^3/s 9800 m^3/h and at a temperature of approximately 5^0C during the whole winter. By air pressure measurements it has been possible to deduce that the well withdraws soil air from at least a 60 m radius from the well. Economical calculations show that the low cost of electricity in Sweden today makes supplementary resistance heating more economical than an investment in an air well for withdrawal of soil air. The well mentioned above was built in order to develop a method to reduce soil radon infiltration in one-family houses situated on the esker. When serving double purposes, it will be economical to use the soil air for a heat pump in one of the houses. 6 refs., 3 figs., 1 tab.

33724 (LBL–22473) **Potential risks from exposure to organic compounds in indoor air.** McCann, J.; Horn, L.; Girman, J.; Nero, A.V. Lawrence Berkeley Lab., CA (USA). May 1988. 177p. Sponsored by DOE Energy Research. DOE Contract AC03-76SF00098. Order Number DE89013403/JAW. Available from NTIS, PC A09/MF A01 - OSTI; GPO Dep.

This report is a preliminary assessment of the potential risks of cancer, reproductive effects, and miscellaneous toxic effects from exposures to individual organic compounds which have been detected in indoor air. Published data in indoor concentrations of organic compound were compiled. The principal basis for estimates of cancer were data from animal studies. Potency factors used in the risk calculations were estimated by EPA and by other authors. EPA potency factors were estimated by "unit risk," the lifetime risk to humans from daily inhalation of a unit concentrations (e.g., 1 $\mu g/m^3$). A TD50 is defined as the daily dose rate that would induce tumor in half the test animals that would have remained tumor-free at zero dose. TD50s were converted to "human equivalent inhalation" TD50s to estimate cancer risks for median and maximum concentrations. Maximum likelihood (MLE) risks and 95% upper confidence limit risks were also calculated. For reproductive effects, the "lowest effective dose" (LED) in animals was converted to a "human equivalent inhalation" dose and compared to the maximum and the mean or median indoor concentrations reported for that compound. Based on the limited data available, it is concluded that risks of adverse health effects do not appear to be large in the great majority of homes. In some fraction of homes, however, a significant health risk may exist. 60 refs., 5 figs., 13 tabs.

33725 (LBL–23035) **Applications of a simplified model for predicting air flows in multizone structures.** Haugen, T.; Feustel,

H.E. Lawrence Berkeley Lab., CA (USA). Jul 1987. 33p. Sponsored by DOD;DOE/CE. DOE Contract AC03-76SF00098. BA7002.18414. Order Number DE89013405/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A simplified pocket calculator model has been developed which can simulate the air flow distribution in multizone structures. The model is based on lumped parameters and includes several assumptions to simplify the description of air flow due to wind and stack effect and their superimposition. This paper gives a brief overview of the model and describes several applications. Results for simulation runs using the simplified model are compared with results obtained from a mainframe based research tool. The examples show that the simplified method can be used to predict air mass flows within reasonable accuracy for different types of buildings. We are able to calculate air flows due to wind or stack effect within a few percent difference from results calculated with a detailed model. We might expect larger differences when superimposing flows caused by different effects. 9 refs., 11 figs., 9 tabs.

33726 (LBL–23151) **A model for predicting air flows through two combustion appliances vented by a single chimney.** Dumortier, D.; Modera, M.P. Lawrence Berkeley Lab., CA (USA). Oct 1987. 79p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract AC03-76SF00098. Order Number DE89013406/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

This report describes the development of a computer program that predicts air flows and temperatures in a chimney venting two combustion appliances. Mass conversion, energy conservation and pressure loss equations are used in conjunction with a thermal model of a chimney to define the system. The resulting system of 18 equations and 18 unknowns is reduced to a single equation, which is then solved by a numerical method. Although the model is generally applicable to venting systems serving two combustion appliances, the case which is examined in detail is that of a steam boiler and domestic hot water heater (DHW) connected to a common masonry chimney in a multifamily building. This installation is typical of those encountered in turn-of-the-century construction in midwestern and northwestern US cities. The computations required to determine the leakage areas of each of the components of the venting system are described, as is a preliminary examination of the model performed by comparing air flow and temperatures predictions with measured values for the multifamily boiler-DHW system. The comparison showed good agreement between predictions and experimental results, however a more thorough evaluation of model predictions for systems with and without vent dampers would be appropriate. 13 refs., 8 figs., 5 tabs.

33727 (LBL–23886) **Review of wind pressure distribution as input data for infiltration models.** Kula, H.G.; Feustel, H.E. Lawrence Berkeley Lab., CA (USA). Dec 1988. 40p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract AC03-76SF00098. Order Number DE89013407/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Previous investigations have shown that the pressure difference between the inside and outside of the building is one of the driving forces for air infiltration. This pressure difference mainly depends on the wind and its interaction with the envelope of the building which is commonly expressed as dimensionless pressure coefficients. The main part of this report is a literature review on the wind pressure distribution around the building, with emphasis on high-rise buildings. Reports of single family buildings were also reviewed and evaluated. In the second part of this paper, an examination wind pressure distribution curves on the centerline of the windward and leewardside of the building was done and a polynomial fit is presented. This set of coefficients covers a wide range of buildings of varying heights and varying plan area densities. 29 refs., 14 figs., 20 tabs.

33728 (LBL–23979) **Pacific Northwest existing home indoor air quality survey and weatherization sensitivity study: Final report.** Turk, B.H.; Grimsrud, D.T.; Harrison, J.; Prill, R.J.; Revzan, K.L. Lawrence Berkeley Lab., CA (USA). Feb 1988. 156p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract AC03-76SF00098. Order Number DE89013408/JAW. Available from NTIS, PC A08/MF A01 - OSTI; GPO Dep.

In a survey of 111 homes in the Pacific Northwest, indoor levels of formaldehyde (HCHO), nitrogen dioxide (NO_2), and water vapor were found to be significantly below levels of concern. Indoor radon concentrations were elevated in homes in the Spokane River Valley/ Rathdrum Prairie region of eastern Washington and northern Idaho, which has highly permeable soil that encourages convective flow of radon-bearing soil gas. Forty-eight of these homes were studied to evaluate the effects of house weatherization on indoor air pollutant concentrations. Standard weatherization techniques reduced the specific leakage area (SLA), as measured by a blower door in 40 homes by 12.5%, while the reduction in SLA due to wall insulation alone was not statistically significant. House doctoring in five homes resulted in an additional 26% decrease in SLA. Mean ventilation rates, measured with perfluorocarbon tracers (PFT) and uncorrected for environmental conditions, were 0.37 h^{-1} before weatherization and 0.39 h^{-1} after weatherization. These values were 20% lower than ventilation rates predicted using the LBL model. Good mixing of the indoor air causes uniform distribution of HCHO, NO_2, and H_2O vapor throughout interiors of the buildings. Respirable suspended particle (RSP) and NO_2 concentrations were low in those homes without tobacco smokers or without frequently used combustion appliances and were not dependent on high outdoor levels. Changes in concentrations of all pollutants and ventilation rates were generally small and essentially uncorrelated. Simplified models were developed to evaluate the impact of weatherization on normalized HCHO, H_2O vapor, and radon levels. 42 refs., 42 figs., 33 tabs.

33729 (LBL–24052) **Energy use in Minnesota schools: Aggregate performance and perspectives on energy savings.** Vine, E.; Hatfield, B.; Lebot, B.; Kammerud, R.; Carroll, W.L. Lawrence Berkeley Lab., CA (USA). Jul 1988. 30p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract AC03-76SF00098. Order Number DE89013397/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

As part of an extensive and comprehensive evaluation of the US Department of Energy's Institutional Conservation Program (ICP), we present an analysis of the energy performance of Minnesota schools during the 1970s and 1980s. We also estimate energy savings for individual schools and for the entire group of schools participating in the ICP. Finally, we compare estimated energy savings, based on technical audits, with monitored energy reductions. 13 refs., 7 figs., 3 tabs.

33730 (LBL–24216) **Indoor environment program, FY 1987 annual report.** Lawrence Berkeley Lab., CA (USA). Mar 1988. 41p. Sponsored by DOE Energy Research. DOE Contract AC03-76SF00098. Order Number DE89013398/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

LBL is a major center of building science research. An important part of that research is the environment defined by the building – the major focus of the work of the Indoor Environment Program. The Program examines the scientific issues associated with the design and operation of buildings to optimize building energy performance and occupant comfort and health. Optimizing health and comfort of occupants is addressed in different ways by the groups that comprise the Program. The Energy Performance of Buildings Group examines energy flow through all elements of the building shell. It measures air infiltration rates, studies thermal characteristics of structural elements, and develops models of the behavior of complete buildings. The potential for savings in the infiltration area is great. The heat load associated with natural infiltration is about 2.5 quads/yr costing about $15 billion annually. It may be economic to reduce this by 25%.

33731 (LBL–25080) **Technology assessment: Adjustable-speed motors and motor drives: (Residential and commercial sectors).** Greenberg, S.; Harris, J.P.; Akbari, H.; de Almeida, A. Lawrence Berkeley Lab., CA (USA). Mar 1988. 69p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract AC03-76SF00098. Order Number DE89012831/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

This report, one of a series of end-use energy technology assessment reports, investigates the use of adjustable-speed drives for electric motors in residential and commercial buildings. The end uses for motors and drives are ventilating, air conditioning, refrigeration, and space heating and water heating equipment that uses

heat pumps. The aim of these investigations is to synthesize current information from both published and unpublished sources so that utilities, state regulatory commissions, and others can better identify, evaluate, and select demand-side resources to meet their needs. In addition, we attempt to identify and, if possible, reconcile variations or discrepancies among data sources. The material covered in these reports is not limited to "success stories," but also includes failures, barriers, uncertainties, and information gaps. The report is designed to be easily updated in the future, as the technology develops and better data become available. 133 refs., 10 figs., 6 tabs.

33732 (LBL–25211) **Macromodel for assessing residential concentrations of combustion-generated pollutants: Model development and preliminary predictions for CO, NO_2, and respirable suspended particles.** Traynor, G.W.; Aceti, J.C.; Apte, M.G.; Smith, B.V.; Green, L.L.; Smith-Reiser, A.; Novak, K.M.; Moses, D.O. Lawrence Berkeley Lab., CA (USA). Jan 1989. 167p. Sponsored by DOE/CE;DOE/ER. DOE Contract AC03-76SF00098. Order Number DE89013396/JAW. Available from NTIS, PC A08/MF A01 - OSTI; GPO Dep.

A simulation model (also called a "macromodel") has been developed to predict residential air pollutant concentration distributions for specified populations. The model inputs include the market penetration of pollution sources, pollution source characteristics (e.g., emission rates, source usage rates), building characteristics (e.g., house volume, air exchange rates), and meteorological parameters (e.g., outside temperature). Four geographically distinct regions of the US have been modeled using Monte Carlo and deterministic simulation techniques. Single-source simulations were also conducted. The highest predicted CO and NO_2 residential concentrations were associated with the winter-time use of unvented gas and kerosene space heaters. The highest predicted respirable suspended particulate concentrations were associated with indoor cigarette smoking and the winter-time use of non-airtight wood stoves, radiant kerosene heaters, convective unvented gas space heaters, and oil forced-air furnaces. Future field studies in this area should (1) fill information gaps identified in this report, and (2) collect information on the macromodel input parameters to properly interpret the results. It is almost more important to measure the parameters that affect indoor concentration than it is to measure the concentrations themselves.

33733 (LBL–25465) **Evaluation of soil-gas transport of organic chemicals into residential buildings: Final report.** Hodgson, A.T.; Garbesi, K.; Sextro, R.G.; Daisey, J.M. Lawrence Berkeley Lab., CA (USA). Jun 1988. 90p. Sponsored by DOE/CE;DOE/ER. DOE Contract AC03-76SF00098. Order Number DE89013394/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

This investigation consisted of theoretical, laboratory, and field study phases with the overall objective of determining the importance of pressure-driven flow of soil gas in the transport of volatile organic compounds (VOC) from soil into a house. In the first phase, the mechanisms of advection, diffusion, and retardation of VOC in soil were evaluated. Using the theory of fluid mechanics and empirical for equilibrium partitioning of VOC among gas, aqueous, and solid phase of soil, a one-dimensional advection-diffusion equation or the transport of gas-phase VOC through soil was developed. An experimental apparatus and method were developed for the direct observation of pressure-driven transport of VOC through soil under controlled laboratory conditions. The retardation of sulfur hexafluoride (SF_6) and hexafluorobenzene with respect to the flow of the bulk gas was measured in soil-column experiments using different soils and soil-moisture conditions. The results were in good agreement with theoretical predictions. Since SF_6 was not lost by sorption to soil, it was selected for use as a tracer gas in the field study to study the advective flow of soil gas. The overall objective of the investigation was directly addressed by the field study. This study was conducted at a house which has a basement and which was located adjacent to a covered municipal landfill. The soil at the site was characterized, pressure coupling between the basement and surrounding soil was measured, the entry rate of soil gas as a function of basement depressurization was measured, and VOC in soil gas, indoor air and outdoor air were quantified. 46 refs., 18 figs., 11 tabs.

33734 (LBL–25718) **The impact of gas furnace operation on radon concentrations in residences: A literature survey.** Grimsrud, D.T.; Odenwalder, D.M. Lawrence Berkeley Lab., CA (USA). Aug 1988. 21p. Sponsored by DOE/CE;OUS. DOE Contract AC03-76SF00098. Order Number DE89012853/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Radon entry into residences is dominated by the pressure-driven flow of radon-bearing soil gas into the building substructure. The pressure difference driving this flow is caused by the wind, the indoor-outdoor temperature difference, and the operation of ventilation systems that exhaust indoor air to the outside. Combustion-fired furnaces are physical analogs of exhaust ventilation systems and therefore might be expected to cause an increase in the radon entry rate. This survey summarizes the information in the literature that relates furnace activity to indoor radon concentrations. Little direct experimental evidence links the two. The survey then examines literature that relates furnace activity to related parts of the problem. Based on the results of this search and current models of radon entry we conclude that at the present time it is not possible to predict if furnace activity would cause an increase or decrease in radon concentrations in a house. 27 refs., 3 figs.

33735 (LBL–26306) **Pollutant emission rates from a radiant fiber-matrix unvented gas space heater.** Apte, M.G.; Traynor, G.W. Lawrence Berkeley Lab., CA (USA). Jan 1989. 10p. DOE Contract AC03-76SF00098. Order Number DE89013411/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A prototype unvented gas space heater (UVGSH) using a radiant fiber-matrix burner was operated in a 27 m^3 (950 ft^3) environmental chamber under two firing rates and at two different excess-air settings. Pollutant emission rates for carbon monoxide (CO), nitric oxide (NO), and nitrogen dioxide (NO_2) are reported. When compared to previously tested UVGSH's the radiant fiber-matrix burner was found to emit less CO and NO_2 per unit of fuel consumed. 5 refs., 2 figs., 1 tab.

33736 (LBL–26586) **Applied Science Division annual report: Building Energy Systems Program, FY 1988.** Lawrence Berkeley Lab., CA (USA). Mar 1989. 12p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract AC03-76SF00098. Order Number DE89013389/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The main theme of the Program is the comprehensive simulation, analysis, monitoring, and evaluation of the energy performance of whole buildings, emphasizing nonresidential buildings. Many of the projects develop and apply comprehensive computer models that enable integrated performance analyses of heating, cooling, and daylighting systems. A further activity involved research on absorption heat pumps for solar cooling and gas-driven applications. 18 refs., 3 figs.

33737 (LBL–26588) **Indoor environment program: FY 1988 annual report.** Lawrence Berkeley Lab., CA (USA). Mar 1989. 28p. Sponsored by DOE Energy Research. DOE Contract AC03-76SF00098. Order Number DE89012855/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The Indoor Environment Program examines the scientific issues associated with the design and operation of buildings to optimize energy performance and occupant comfort and health. Optimizing occupant health and comfort is addressed in various ways by groups within the Program. To examine energy flow through all elements of the building shell, the Energy Performance of Buildings Group measures air infiltration rates, studies thermal characteristics of structural elements, and develops simplified models of the behavior of complete buildings. Potential savings in the infiltration area are great.

33738 (LBL–26837) **The impact of the CFC [chlorofluorocarbon] phase-out on PG and E, its customers, and energy use.** Meier, A. Lawrence Berkeley Lab., CA (USA). Oct 1988. 22p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract AC03-76SF00098. Order Number DE89012846/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Chlorofluorocarbons (CFCs) have recently been identified as responsible for the destruction of the earth's ozone layer. The ozone layer shields all living things from, injurious ultraviolet light. The

United States and other countries have agreed to cut their CFC use by 50% in the next decade. Since CFCs are used in activities as diverse as refrigerants, solvents, and foaming agents, this phase-out will have wide-ranging impacts on the economy. Some aspects of the phase-out will have little or no impact on PG and E. These include auto air conditioning, solvents, and aerosol sprays. These may have indirect effects because alternatives and better containment will be more or less energy-consuming. In other cases, CFC applications have energy linkage. These linkages occur principally through their use as refrigerants and foaming agents for insulation. Residential refrigerators, commercial building chillers, and commercial refrigeration systems will be the most disrupted by the CFC phase-out and this could have an impact on the demand for electricity and gas because they are major users of CFCs. Curiously, most of the measures to reduce CFC use in chillers will result in lower electricity use and an improved load shape. The continued improvement in efficiency of residential refrigerators is threatened by the loss of the traditional refrigerants and the best available insulation materials (which use CFCs as a blowing agent). Finally, rigid insulation, which us a popular residential and commercial building material, will be much more expensive and possibly in short supply. These shortages may lead to increased electricity and gas use for space conditioning. 37 refs., 3 tabs.

33739 (LBL–26952) **Economics of efficiency improvements in residential appliances and space conditioning equipment.** Levine, M.D.; Koomey, J.; Ruderman, H.; Craig, P.; McMahon, J.; Chan, P. Lawrence Berkeley Lab., CA (USA). Sep 1985. 25p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract AC03-76SF00098. Order Number DE89012844/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The large amounts of energy consumed by residential appliances and space conditioning equipment make this sector a fruitful area for efficiency improvements. We examine eight major residential appliances that in the US currently consume 9.4 exajoules/year (8.9 quads/year) representing more than 12 percent of total 1984 US energy use. Expenditures on energy for these appliances totaled over $56 billion in 1984. Or results indicate that improving the efficiency of all these appliances to economically optimal levels would reduce these annual expenditures by almost thirty percent, a savings of $17 billion per year. In steady state, the annualized additional investment cost to achieve this efficiency improvement is $7 billion, so the net savings is about $10 billion per year. This paper describes and analyzes energy efficiency choices for residential appliances and space conditioning equipment. 7 refs., 5 figs., 8 tabs.

33740 (LBL–27206) **Data specification protocol for multifamily buildings.** Szydlowski, R.F.; Diamond, R.C. Lawrence Berkeley Lab., CA (USA). May 1989. 49p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract AC03-76SF00098. Order Number DE89012843/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The objective of this Data Specification Protocol is to establish a standardized experimental research plan (e.g., a set of procedures and specifications) usable by a wide variety of users, identifying the critical data parameters needed to determine the energy performance of multifamily housing energy conservation retrofits. The protocol specifies the data points to be monitored, the frequency at which they should be measured and recorded, and the locations of the sensors. 11 refs.

33741 (PB–89-140842/XAB) **Integrated gas-fired desiccant dehumidification vapor-compression cooling system for residential application. Phase 1. Final report, December 1986-December 1987.** Lowenstein, A.; Marsala, J.; Spatz, M.; Feldman, S.; Tandler, J. TECOGEN, Inc., Waltham, MA (USA). Nov 1988. 102p. (TR–4442-209-88). Available from NTIS, PC A06/MF A01.

The development of an air conditioner that uses a liquid-desiccant dehumidifier is described. Three air-conditioning systems that integrate the operation of a conventional vapor-compression system with a liquid-desiccant dehumidifier were first simulated in seasonal performance studies. These studies showed that there was little benefit from attempting to recover reject heat from the vapor-compression system for regenerating the liquid desiccant. The preferred version of the liquid-desiccant dehumidifier was one that used a simple gas-fired boiler for regenerating the desiccant. When added to a conventional vapor-compression air conditioner, this liquid-desiccant system could maintain comfortable humidity levels in the living space for almost the entire cooling season at a modest premium in operating costs.

33742 (PW–DOS) **Component evaluation energy performance.** Public Works Canada, Ottawa, ON (Canada). 1988. 77p. (In English and French). (MICROLOG–89-01907). Available from Public Works Canada, Information Research & Library Services, Sir Charles Tupper Bldg., Confederation Heights, Ottawa, ON, Canada K1A 0M2; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Finding energy conservation opportunities in a building is done according to this document by using a component evaluation of energy use. The procedure follows an overall evaluation and proceeds to a detailed equipment evaluation. A disaggregated pattern of energy consumption is developed to determine the amount of energy used or lost. These components can be defined as general energy sources (oil and electricity), broad categories (heating systems and lighting), or more specific items (parking lot lighting and chiller consumption). The process defines energy by weather and occupant sensitivity. This document provides methods of disaggregation and suggests scheduling changes to save energy. The appendices show how to measure energy usage or loss. The evaluation leads to the identification of energy inefficiency, and can also be used to check the results of more comprehensive evaluations. 7 refs., 5 figs.

33743 (SERI/TP–254-3492) **Algorithms for builder guidelines.** Balcomb, J.D.; Lekov, A.B. Solar Energy Research Inst., Golden, CO (USA). Jun 1989. 5p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract AC02-83CH10093. (CONF-890610–4: ASES annual meeting and 14th annual passive solar conference, Denver, Colorado, USA, 19-23 Jun 1989). Order Number DE89000870/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The Builder Guidelines are designed to make simple, appropriate guidelines available to builders for their specific localities. Builders may select from passive solar and conservation strategies with different performance potentials. They can then compare the calculated results for their particular house design with a typical house in the same location. Algorithms used to develop the Builder Guidelines are described. The main algorithms used are the monthly solar ratio (SLR) method for winter heating, the diurnal heat capacity (DHC) method for temperature swing, and a new simplified calculation method (McCool) for summer cooling. This paper applies the algorithms to estimate the performance potential of passive solar strategies, and the annual heating and cooling loads of various combinations of conservation and passive solar strategies. The basis of the McCool method is described. All three methods are implemented in a microcomputer program used to generate the guideline numbers. Guidelines for Denver, Colorado, are used to illustrate the results. The structure of the guidelines and worksheet booklets are also presented. 5 refs., 3 tabs.

33744 (SV–2000-88-1201) **Partial conversion of direct-electric heated single family residence with a small heat pump. Pilot project progress report after 2.5 month follow-up.** Ejeklint, L.; Nilsson, L. Swedish State Power Board, Vaellingby (Sweden). 1 May 1988. 47p. (In Swedish). Order Number DE89776226/JAW. Available from NTIS (US Sales Only), PC A03/MF A01;1.

In January 1988 a 2.5 kW heat pump was installed in an electric heated house at Kalix. The system works by direct evaporization in a borehole in ground/rock and direct condensation in an indoors fan condenser. The heat pump compressor is on-off controlled by a room thermostat. The described concept could be interesting in a future out of national economy perspective. However, the way of heat distribution is unrational. The difficulty is to spread the heat for the benefit of the entire house. This limits the electricity conservation and results in a worse indoor-climate by unequal temperature distribution between rooms. The heat distribution could be improved at a moderate cost thus noticeably increasing electricity conservation and also minimizing the negative influence on living comfort. Partial conversion of houses with water-borne electric heating should be very favourable. By using existing radiator system a heat pump of the size discussed would cover 70-80% of the energy requirements for heating. (O.S.).

33745 (TKK-KO/LVI–B18) **Effect of air humidification on the health and comfort of office workers.** Reinikainen, L.; Jaakkola, J.; Heinonen, O.; Lindholm, M. Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning. 1988. 110p. (In Finnish). Order Number DE89776183/JAW. Available from NTIS (US Sales Only), PC A06/MF A01;1.

During the winter months indoor air in Finnish office buildings may be extremely dry, having relative humidity less than 10 per cent. Artifical humidification of indoor air is not common in Finland, because of the expenses caused by the humidification and because of the uncertainty concerning the benefits of air humidification. The aim of this study was to evaluate the effect of air humidification on the symptoms and complaints of office workers in a modern 8 floor office building of 2150 workers in Helsinki. A small part of the building is humidified. Symptoms and complaints of the workers in the humidified part of the building (122 persons) were compared with those of the workers in similar unhumidified rooms (135 persons). The epidemiological evidence was based on three questionnaires sent to the workers in February, March and April 1985. The frequency of complaints against continuous dryness of air was clearly and significantly smaller in the humidified part of the building in all three cross sectional surveys. In all three inquiries the workers in the humidified part of the building complained significantly more often a basic odor in their working room. There were more complaints about dustiness of air in the humidified part of the building. The difference was statistically significant in the first inquiry. In the first and second inquiries significantly more complaints against air stuffiness were reported in the humidified part of the building.

33746 (TKK-KO/LVI–B19) **Requirements for air conditioning control devices and processes.** Jermilae, V.; Siren, K. Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning. 1988. 173p. (In Finnish). Order Number DE89776173/JAW. Available from NTIS (US Sales Only), PC A08/MF A01;1.

The aim of the study was to develope such requirements, which would quarantee at least an acceptable operation for an installed air handling system under all circumstances. To reach the goal, requirements for both controls and processes were developed. The control demands are directed to devices not installed in the process. Here the state of the available air conditioning control devices has been taken into account by making a market survey in Finland. The fulfilment of the requirements is found out using manufacturers brochures. The process demands concern the control of temperature and humidity in the central air handling unit and the control of temperature only only in zones and rooms. Additionally systems producing air with constant temperature and systems with room air temperature or return air temperature control have been separately handled. The demands are directed to the standstill time, the start, the run time and the change of the reference variable. A simple measurement procedure has been developed to ascertain the fulfilment of the process requirements.

33747 **A room air stratification model for TRNSYS.** Bechtel, T.N. (Colorado Energy Associates, Fort Collins, CO (US)); Armstrong, P.R. v.v of Solar '88 (Technical Papers). Coleman, M.J. American Solar Energy Society, Boulder, CO (1988). (CONF-880615–: Solar '88: American Solar Energy Society annual meeting and 13th national passive solar conference, Cambridge, Massachusetts, USA, 18-24 Jun 1988).

A two-stratum model is described. The model accounts for energy transfers in rooms with heat sources or supply and return air registers at different elevations. The stratum interface is modeled as a TRNSYS TYPE19 window with solar transmissivity = 1.0 to solar and electric light radiation. Thermal radiation exchange is modeled as an equivalent conduction through the window. The actual directional distributions of diffuse visible and thermal radiation are therefore approximated as uniform hemispherical distributions at the stratum interface. Convection is treated as an internal heat gain to one stratum air node and a corresponding loss to the other. Two film coefficients are used for convection heat transfer across the interface, one for upward heat convection, the other for downward conduction. A major difference between mixed and stratified room models, the treatment of infiltration and forced air heating, cooling and ventilation, is discussed. The simple stratification model has been validated using two weeks of data taken at 15 minute intervals in the EPI building. Simulated stratum temperature differences were within ±25% of measured. These deviations are consistent with the deviations of simulated from measured absolute stratum temperatures.

33748 **PRISM: a tool for tracking retrofit savings.** Mills, E. (Lawrence Berkeley Lab., CA (USA)); Fels, M.; Reynolds, C. *Energy Auditor and Retrofitter (USA)*, 4(6): 27-36 (Nov-Dec 1987).

Careful examination of utility bills before and after a conservation retrofit - a process known as score keeping - is becoming a preferred technique for verifying predicted energy savings. One score keeping method, PRISM, has been widely used and tested by energy auditors, consultants, conservation-program directors, energy-service companies, and researchers. PRISM is a computer program that calculates a weather - corrected index of energy consumption. Developed for a mainframe computer, it is now also available for IBM personal (or IBM-compatible) computers.

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33749 (PB–89-143424/XAB) **Study of the impact of automation on productivity in bus-maintenance facilities. Final report.** Sumanth, D.J.; Weiss, H.J.; Adya, B. Miami Univ., Coral Gables, FL (USA). Dec 1988. 98p. Available from NTIS, PC A05/MF A01.

Whether or not the various types of automation and new technologies introduced in a bus-transit system really have an impact on productivity is the question addressed in the study. The report describes a new procedure of productivity measurement and evaluation for a county-transit system and provides an objective perspective on the impact of automation on productivity in bus maintenance facilities. The research objectives were: to study the impact of automation on total productivity in transit maintenance facilities; to develop and apply a methodology for measuring the total productivity of a Floridian transit maintenance facility (Bradenton-Manatee County bus maintenance facility which has been introducing automation since 1983); and to develop a practical step-by-step implementation scheme for the total productivity-based productivity measurement system that any bus manager can use. All 3 objectives were successfully accomplished.

33750 (PB–89-145288/XAB) **Evaluation of the spare-ratio concept in the management of transit rolling stock. Final report.** Iskander, W.H.; Jaraiedi, M. West Virginia Univ., Morgantown, WV (USA). Harley O. Staggers National Transportation Center. Nov 1988. 181p. Available from NTIS, PC A09/MF A01.

This research investigates the problem of spare vehicles and maximum operating spare ratios in bus-transit systems. The report should be of interest to transit agencies interested in managing transit assets. It reflects concerns that the determination of spare ratio and factors affecting its magnitude have not been extensively studied, and that transit systems with a spare ratio in excess of the specified maximum (120%) will not be eligible for federal capital resources to purchase, rehabilitate, or store transit vehicles. The model studied the effect of time between bus breakdown and time to repair broken buses as well as other characteristics of the system on the value of spare ratio and the overall performance of the system. The model was successfully validated and used to simulate and study bus operations of the Kanawha Valley Regional Transportation Authority in Charleston, West Virginia.

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Refer also to citation(s) 33190, 33191, 33192, 33354, 33395, 33405, 33431, 33563, 33603, 33652, 34077

33751 (BFR-R–86-1988) **Storage of waste heat in a rock cavern and borehole heat store in Vaenersborg.** Gustafson,G. Swedish Council for Building Research, Stockholm (Sweden). 1988. 56p. (In Swedish). Order Number DE89776239/JAW. Available from NTIS (US Sales Only), PC A04/MF A01;1.

Waste heat from the Vargoen Alloys plant is used for energy supply to Holmens Bruk and to the public district heating system in Vaenersborg. Incorporation of a seasonal heat store would allow greater use to be made of waste heat in the district heating system.

An earlier report concerned an economic feasibility study of a heat store in rock at Vaenersborg. Since then, the conditions relating to implementation of a heat store project have changed in several respects. This present investigation is concerned with the feasibility, under present circumstances, of constructing a combined rock cavern and borehole heat store. The suggested size of the store is about 10 GWh. As a result of the reduced quantity of waste heat from Vargoen Allays, together with the general reduction in energy production costs in recent years, there is at present less interest in realizing a heat storage project of this type.

33752 (BNL-tr–1074) **Heat transfer in bubble columns.** Koelbel, H.; Siemes, W.; Maas, R.; Mueller, K. 18p. Translated from Chemie-Ingenieur-Technik (F.R. Germany). *Chemie-Ingenieur-Technik (F.R. Germany),* 20(6): 400-404 (1958). Sponsored by DOE Energy Research. DOE Contract AC02-76CH00016.

Sufficient dimensioning of cooling and heating surfaces in bubble column reactors requires knowledge of the heat transfer coefficient under different operating conditions. The heat transfer on pipes that were suspended in bubble columns were investigated as a function of various parameters. The heat transfer is particularly strongly dependent on the gas velocity and the viscosity of the liquid. The results can be described by exponential functions. 15 refs.

33753 (DOE/BP/39166–1) **The role of electricity in Pacific Northwest irrigated agriculture, 1979–1987: Volume 1, A study of irrigation price elasticity of demand, the importance of irrigated agriculture to rural communities, and an evaluation of alternative targeted rate discount options for irrigation consumers.** Northwest Economic Associates, Vancouver, WA (USA); Washington State Univ., Pullman, WA (USA). May 1989. 91p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract AC79-88BP39166. Order Number DE89013080/JAW. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

Increased regional pressure for and against the wholesale rate discount has prompted BPA to evaluate the quantitative, qualitative, economic, and policy issues associated with an irrigation rate discount. BPA determined that more information was required in the following areas: Irrigation price elasticities at the subregional level (utility, group of utilities and/or production areas), importance of irrigated agriculture to local and regional economies, issues related to targeting an irrigation rate discount, and the role of BPA wholesale rates and rate discounts on Pacific Northwest sprinkler irrigation and the supporting economies. In response to this request for additional information, the analysis in the present study is conducted in four parts: Document the importance of irrigated agriculture, particularly sprinkler irrigated agriculture, to the Pacific Northwest economy and quantify the impact of the rate discount on regional agriculture and local communities; Estimate irrigation price elasticities for BPA customers at a subregional level, so that load impacts associated with the rate discount can be evaluated at a more localized level; Identify the economic, policy, and practical application issues associated with targeting a rate discount to groups of utilities or irrigators; and Review the short-term economic and policy outlook for irrigated agriculture in the Pacific Northwest and draw implications regarding the impact on producer response to electricity rates. 40 refs., 1 fig., 24 tabs.

33754 (DOE/OR/21400–T352) **An economic and energy evaluation of the replacement of conventional technology with continuous chromatography in the production of high-fructose sugar.** Byers, C.H.; Holmes, J.M. Oak Ridge National Lab., TN (USA). Oct 1988. 63p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. Order Number DE89010393/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

As a major portion of a program to assess the energy and economic advantages of using the concept of continuous chromatography as a replacement technology for the separation portion of a number of technologies, a representative the burgeoning biotechnology area was sought, where there is significant developmental activity, and one which represents a sufficiently large annual production to have a significant energy impact on a national scale. The production of high fructose sugars was selected as the candidate system which met these criteria. A trend in the sugar industry is the replacement of sucrose with fructose from corn. Fructose is considerably sweeter than sucrose per unit weight and thus lower in calories for equivalent sweetness. The process which begins with corn starch leads high-fructose corn syrup (HFCS), a mixture of fructose, glucose and higher-molecular-weight materials. HFCS is produced in a sequence of five principal operations. The three of direct interest here are breakdown of the hydrolyzate polymer to individual glucose molecules using glucoamylase enzyme (saccharification), conversion of the glucose to a mixture of glucose and fructose, containing ~42% fructose, using immobilized glucose isomerase enzyme (isomerization); and separation unit. The primary function of the separation step is to concentrate the product to a 55% fructose, which accounts for about half the current output. Further there is a growing demand for 99+% fructose, from which crystalline material is made. This study focuses on the replacement of the separation unit, currently based on the SAREX process, with the continuous annular chromatograph (CAC), a recently-developed concept in multicomponent separations. 37 refs., 15 figs., 11 tabs.

33755 (DOE/OR/21400–T357) **An economic and energy evaluation of the replacement of conventional technology with continuous chromatography in the dump leaching of copper ores.** Byers, C.H.; Begovich, J.M.; Holmes, J.M. Oak Ridge National Lab., TN (USA); JMH Associates, Knoxville, TN (USA). Feb 1989. 239p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. Order Number DE89009038/JAW. Available from NTIS, PC A12/MF A01 - OSTI; GPO Dep.

The focus of this investigation is an economic and energy analysis of the implementation of CAC (continuous annular chromatography) to a large-scale industrial process. The technology selected is the dump leaching of copper and other metal values from low-grade copper ores. The portion of the presently used process to be placed in this case is the solvent extraction (SX) train in which the copper in solution is separated from the leach liquor from dump leaching. Instead of SX, we use the CAC for the separation and immediately obtain two advantages: (1) We can separate all of the metals such as iron, cobalt, and yttrium as well as copper in one operation, thus reducing the plant size and increasing the total metal values recovered; and (2) we exit with purer and more concentrated steams, thus improving the energy and economic picture. To scale the CAC, we have developed a model for the process which is implemented in ASPEN (Advanced System for Process Engineering). Modules for both the mass/energy balance part and the economics were implemented in ASPEN. ASPEN is a state-of-the-art process simulator which was originally written for the Department of Energy to be used in evaluating processes which are similar to the one we are considering. It allows one to perform the most complex material and energy balances automatically and to tie these in the same simulation to the economic evaluations of the process in question. Our implementation is an advanced version of the simulator, is distributed by JSD Associates.

33756 (DOE-tr–118) **Macro- and micromixing in strirred tanks.** Geisler, R.; Mersmann, A.; Voit, H. 35p. Translated from Chemie-Ingenieur-Technik (F.R. Germany). *Chemie-Ingenieur-Technik (F.R. Germany),* 60(12): 947-955 (1988). Sponsored by DOE Defense Programs. DOE Contract AC09-76SR00001.

Macromixing time, based on turbulence theory, is calculated theoretically as a function of the specific power input, the kinematic viscosity, the Schmidt number, and the degree of segregation. A comparison of the micromixing time with data for macromixing found in literature reveals that the micromixing time governs the reaction for very small vessel diameters. If the vessel diameter is greater than the critical size than the turbulent macromixing time controls the mixing process. The micromixing time θ_{mikro} is calculated by means of the experimental results of the turbulent velocity distributions in different stirred vessels for several geometrical arrangements of stirred tanks and different positions of feed input. The calculated data for turbulent mixing times are only valid for geometrically optimized stirred vessels. The necessary mixing time may increase or, if a chemical reaction of 2nd order takes place, the desired yield of the product may decrease considerably if the geometrical conditions are not taken into account. 28 refs., 9 figs.

33757 (KTM/E-D–166) **Development of mathematical models and computational routines for the timber drying process.** Salin, J.G. Kauppa-ja Teollisuusministerio, Helsinki (Finland).

Energiaosasto. 1989. 152p. (In Finnish). Order Number DE89776162/JAW. Available from NTIS (US Sales Only), PC A08/MF A01;1.

Based on experience obtained elsewhere, a model for drying of timber according to Finnish procedures has been developed. The model is a simplified version of Kayihan's theory and computer programs for both batch and progressive kiln drying have been written. Process variables (drying time, final MC, momentary air exchange and drying rate, total energy consumption etc.) may be calculated with the models as functions of different factors (drying schedule, initial MC, wood species and dimension, sticker thickness, air leakage, progressive kiln length etc.). As timber degrade during drying may be more important than, for instance, energy costs, the possibilities to predict these changes have been investigated. The most important quality change is checking, which is caused by internal stress induced by shrinkage of the wood. The drying simulation programs have thus been extended with a simultaneous stress calculation routine. Creep behaviour of wood, which is very important for check formation, has been accounted for in these calculations. The observed correlation between calculated stress and measured timber degrade is good. Computer simulation programs developed in this project have been proven useful for investigating different questions in connection with tiber drying, such as improving existing drying kiln operation, optimizing drying schedules and testing of new process ideas.

33758 (OAE–88-5102) **Curing and storing sweet potatoes in a modified bulk tobacco kiln.** Ontario Agriculture Energy Centre, Guelph (Canada). 1988. 31p. (MICROLOG–89-01134). Available from Agricultural Energy Centre (Guelph Agriculture Centre), P.O. Box 1030, Guelph, ON, Canada N1H 6N1; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A bulk tobacco kiln was modified to cure and store 11.4 tonnes of Ontario-grown sweet potatoes. The blower/burner unit of the bulk tobacco kiln was not utilized. Instead, a 4.8 kW heater and a fan rated at 900 l/s @ 90 pascals were used to provide heat and aeration respectively. The insulation value of the kiln's roof was upgraded to prevent condensed moisture from dripping on the sweet potatoes during curing and storage. Curing conditions used were 26 to 30^{0}C @ 88 96% relative humidity, while storage conditions used were 13 to 14^{0}C @ 81 to 92% relative humidity. After 7.7 days of curing and 41 days of storage the sweet potatoes lost an average of 8.6% of their weight. Energy consumption was about 910 kWh for curing and 1010 for storage. Marketed quality was considered excellent. 6 refs., 9 figs., 3 tabs.

33759 (OAE–88-9000) **Agricultural Energy Centre.** Ontario Agriculture Energy Centre, Guelph (Canada). 1988. 17p. (MICROLOG–89-01141). Available from Agricultural Energy Centre (Guelph Agriculture Centre), P.O. Box 1030, Guelph, ON, Canada N1H 6N1; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A bibliography is presented of Ontario publications on energy-related topics in agriculture. Publications are listed by report number under general headings of alternate fuels, biomass and solar energy; farm energy in general; feed and crops/grain drying; greenhouse energy; heat pumps; livestock and poultry production; heat exchangers in livestock production; tillage and tractors; and energy on tobacco farms. Lists of slide shows, videotapes, and energy displays/exhibits are also included.

33760 (OAF/AE–87-4508) **Agricultural applications of heat pumps in Ontario.** Ontario Ministry of Agriculture and Food, Toronto, ON (Canada). Agricultural Energy Centre. 1987. 24p. (MICROLOG–89-01130). Available from Agricultural Energy Centre (Guelph Agriculture Centre), P.O. Box 1030, Guelph, ON, Canada N1H 6N1; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The major applications of heat pumps in Ontario agriculture are in horticulture (heating, cooling, and dehumidification in greenhouses and mushroom farms) and in livestock facilities (heating and heat recovery). Specific projects using heat pumps are described, their performance evaluated, and costs are assessed in some instances. It is seen that ground and water source heat pumps provide efficient baseload heating in Ontario horticulture, and are competitive with current energy costs. In livestock applications, use of heat pumps is not as well accepted partly because energy costs in such operations usually form a lower percentage of operating costs than in horticultural applications, and partly because the technology involves more complications. Includes glossary. 16 refs., 9 figs.

33761 (PB–89-138853/XAB) **Field measurements of full-scale hazardous-waste-treatment facilities - organic solvent wastes.** Metcalf and Eddy, Inc., Wakefield, MA (USA). Jan 1989. 216p. Available from NTIS, PC A10/MF A01.

This report describes the treatment of organic hazardous wastes by distillation, thin-film evaporation, incineration, steam stripping, waste blending, carbon adsorption, and activated sludge at full-scale facilities.

33762 (PB–89-142368/XAB) **Best Demonstrated and Available Technology (BDAT) background document for K016, K18, K019, K020, K030. Final report.** Environmental Protection Agency, Washington, DC (USA). Office of Solid Waste. Aug 1988. 289p. (EPA–530/SW-88/031B). Available from NTIS, PC A13/MF A01.

See also PB–89-142376.

This background document provides the Agency's rationale and technical support for selecting the constituents to be regulated in K016, K018, K019, K020, and K030 wastes and for developing treatment standards for those regulated constituents. The document also provides waste-characterization information that serves as a basis for determining whether a variance may be warranted for a particular waste having the same waste code as one of the five wastes above< but with characteristics such that the particular waste is more difficult to treat than the waste for which the treatment standards have been established.

33763 (PB–89-142376/XAB) **Best Demonstrated Available Technology (BDAT) background document for K048, K049, K050, K051, K052. Final report.** Environmental Protection Agency, Washington, DC (USA). Office of Solid Waste. Aug 1988. 531p. (EPA–530/SW-88/031C). Available from NTIS, PC A23/MF A01.

See also PB–89-142368.

This background document provides the Agency's rationale and technical support for selecting the constituents to be regulated in K048, K049, K050, K051, and K052 wastes and for developing treatment standards for those regulated constituents. The document also provides waste-characterization information that serves as a basis for determining whether variances may be warranted for a particular waste having the same waste code as one of the five wastes above, but with characteristics such that the particular waste is more difficult to treat than the waste for which the treatment standards have been established.

33764 (PB–89-142525/XAB) **Amendment to the Best Demonstrated Available Technology (BDAT) background document for F001-F005 spent solvents. Volumes 1 and 2.** Environmental Protection Agency, Washington, DC (USA). Office of Solid Waste. Aug 1988. 45p. (EPA–530/SW-88/031R). Available from NTIS, PC A03/MF A01.

See also PB–87-120267 and PB–87-120275.

The amendment to the Best Demonstrated and Available Technology (BDAT) Background Document for F001-F005 Spent Solvents presents the new data received by EPA and provides EPA's rationale for revising the treatment standard for methylene chloride in F001-F005 wastewaters from the pharmaceuticals manufacturing industry. Section 1.0 provides EPA's legal authority for revision of the treatment standard. Sections 2.0 through 4.0 describe the specific revisions to the November 7, 1986 BDAT Background Document for F001-F005 Spent Solvents.

33765 (PB–89-148837/XAB) **Industrial compact ceramic finned-plate recuperator. Final report, August 1982-March 1987.** Coombs, M.G.; Strumpf, H.; Kotchick, D.; Stillwagon, T. AiResearch Mfg. Co., Los Angeles, CA (USA). Sep 1987. 325p. (REPT–87-60756). Available from NTIS, PC A14/MF A01.

See also PB–84-148097. Portions of this document are not fully legible.

The report covers a multiyear program for the development of a ceramic finned-plate recuperator. The recuperator is designed to

operate in a variety of industrial flue-gas streams with exhaust temperatures of up to 2500F, delivering preheated combustion air at temperatures of up to 2000F. Under anticipated conditions, thermal-efficiency improvements of up to 50% can be achieved, compared to unrecuperated furnaces. A reference system recuperator was designed to meet the requirements of an industrial host site. A scaled-down prototype version of the reference design recuperator was designed to serve as a direct replacement for the GRI tubular ceramic prototpype recuperator in the AiResearch laboratory test facility. The finned-plate recuperator design consists of an assembly of individual ceramic plates with fin patterns formed on both sides of the plates. When assembled, these fin patterns form the alternate air and gas passages in the recuperator. Silicon carbide finned plates were manufactured to demonstrate fabrication feasibility. Following an unacceptable evaluation of the fabricated plates, the program was redirected to evaluate alternative fabrication techniques. The recuperator was redesigned to a new set of system requirements. Silicon nitride finned plates were designed and successfully manufactured for the redesigned recuperator.

33766 (PB–89-148845/XAB) **Performance verification of industrial ceramic materials: environmental effects on performance. Topical report, September 1984-March 1987.** Stillwagon, T.; Kotchick, D.; McNallan, M.; Golemboski, J.; Coombs, M. Allied-Signal Aerospace Co., Torrance, CA (USA). AiResearch Los Angeles Div. Apr 1988. 157p. (REPT–88-61241). Available from NTIS, PC A08/MF A01.

See also PB–87-182218.

The report describes part of a comprehensive research effort performed to verify the performance characteristics of several ceramic materials for use in industrial-size tubular flue-gas recuperators. Three silicon carbide materials (and a supplemental one) were selected from a field of six candidate materials, following a baseline-properties study, for further study. The selected materials were evaluated in tests which simulated severe environmental conditions to determine how these conditions affect performance. Static and cyclic load tests were performed at elevated temperatures to observe their effect on strength. Oxidation studies and sodium and chlorine corrosion tests were conducted to evaluate how the materials are affected by these severe environments.

33767 (PB–89-856280/XAB) **Hazardous-waste constituents: health and environmental effects profiles. January 1970-January 1989 (Citations from the NTIS data base). Report for January 1970-January 1989.** National Technical Information Service, Springfield, VA (USA). Feb 1989. 133p. Available from NTISPC N01/MF N01.

This bibliography contains citations concerning Health and Environmental Effects Profiles prepared by the Environmental Protection Agency. These profiles were prepared to support the listings of hazardous constituents of a wide range of waste streams under Section 3001 of the Resource Conservation and Recovery Act, and to provide health related limits for emergency actions under Section 101 of the Comprehensive Environmental Response, Compensation, and Liability Act. (Contains 220 citations fully indexed and including a title list.)

33768 (PB–89-856298/XAB) **Waste oil reclamation. January 1970-January 1989 (Citations from the NTIS data base). Report for January 1970-January 1989.** National Technical Information Service, Springfield, VA (USA). Feb 1989. 107p. Available from NTISPC N01/MF N01.

Supersedes PB–88-850110.

This bibliography contains citations concerning the reclamation and recycling of used lubricating oils. Topics include specific program descriptions, re-refining techniques, chemical component analysis, and reclaimed oil performance. Appropriate regulations and standards are also discussed. (This updated bibliography contains 169 citations, 14 of which are new entries to the previous edition.)

33769 (PB–89-856421/XAB) **Food-processing waste treatment. January 1976-January 1989 (Citations from the NTIS data base). Report for January 1976-January 1989.** National Technical Information Service, Springfield, VA (USA). Feb 1989. 121p. Available from NTISPC N01/MF N01.

Supersedes PB–87-861910.

This bibliography contains citations concerning methods and equipment utilized in the treatment of food-processing wastes. Specific food industries include meatpacking, fruit and vegetable, seafood, and poultry. Processes and equipment used in the dairy industry are also discussed. (This updated bibliography contains 185 citations, 11 of which are new entries to the previous edition.)

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Refer also to citation(s) 33457, 33761, 34465

33770 (BFR-R–101-1988) **Constructional and operating experience from the GRUDIS system at Hammarstrand.** Persson, S. Swedish Council for Building Research, Stockholm (Sweden). 1988. 65p. (In Swedish). Order Number DE89776234/JAW. Available from NTIS (US Sales Only), PC A04/MF A01;1.

The first experimental district heating system to use the GRUDIS method, which is based on the use of flexible plastic underground piping, was built in Hammarstrand in Jaemtland. This report contains a detailed description of the system in terms of the piping materials, capital costs, experience from the pipe-laying work and groundworks and of operating experience. The cost data obtained shows that the plastic piping is highly competitive in smaller sizes, but that this advantage is reduces by the higher materials costs as the pipe size increases. Total cost savings of the order of 25% have been achieved in comparison with the cost of conventional underground piping.

33771 (BFR-R–102-1988) **Constructional and operating experiences from the GRUDIS system at Vedevaag.** Persson, S. Swedish Council for Building Research, Stockholm (Sweden). 1988. 54p. (In Swedish). Order Number DE89776235/JAW. Available from NTIS (US Sales Only), PC A04/MF A01;1.

The first experimental district heating system to use the GRUDIS method was built in Hammarstrand, and was followed by an experimental installation in the center of Vedevaag in Lindesberg. The report contains a detailed description of the underground piping system in terms of the piping materials, capital costs, experience from the pipe-laying work and groundworks and of operating experience. The results indicate that the plastic piping is highly competitive in smaller sizes (40 mm and 50 mm diameter), for which the cost is over 40% lower than that of steel pipe. For larger sixes (63 mm and 75 mm diameter), costs are about 25% lower than for steel pipe.

33772 (BFR-R–105-1988) **Heat production plant and consumer service units in the GRUDIS system at Vedevaag.** Wallentun, H. Swedish Council for Building Research, Stockholm (Sweden). 1988. 39p. (In Swedish). Order Number DE89776236/JAW. Available from NTIS (US Sales Only), PC A03/MF A01;1.

This report presents operating results for the period from February 1987 until January 1988 from the GRUDIS district heating system in Vedevaag. During this time, the system has operated without any more serious interruptions. Energy production amounted to about 3.0 GWh, of which about 2.1 GWh were supplied by the heat pumps. The report describes how supply main temperature control has operated, how the heat store has been utilised, performance of the heat exchangers, performance of the heat pumps and performance of the consumer service units. Evaluation of the physical performance of the system has formed part of a larger investigation which has also involved measuring the heat losses from, and behavior of the materials of, the underground piping, together with documentation of the method of laying.

33773 (LBL–26627) **The Utility Accounting Package user's manual: Version 1.0.** Bass, J.; Greely, K. Lawrence Berkeley Lab., CA (USA). Dec 1988. 82p. DOE Contract AC03-76SF00098. IAA-H59-87. Order Number DE89013415/JAW. Available from NTIS, PC A05/MF A01 - OSTI.

Utility costs are one of the largest expenses facing Public Housing Agencies (PHAs), amounting to over $1 billion per year. While many PHAs have undertaken modernization projects to reduce their energy use, most are not able to control their energy use effectively. The Utility Accounting Package (UAP) was developed by the Lawrence Berkeley Laboratory (LBL) with the joint sponsorship of the US Department of Housing and Urban Development (HUD) and

the US Department of Energy (DOE) to provide an energy accounting system which can assist PHAs to continually assess and measure their current use of energy and level of energy expenditures. The UAP is also available to owners and managers of other multifamily properties. The UAP consists of computer software written for use in conjunction with Lotus 1-2-3 under the PC-DOS and MS-DOS operating systems on the IBM-PC, PC-XT, PC-AT, or fully compatible personal computers, together with this operating manual. Use of the UAP will permit a PHA to track its utility costs, identify areas where additional energy use reductions can be obtained, and increase its energy efficiency.

33774 (STEV–1988-R12) **IEA District Heating. Small heat meters.** Statens Energiverk, Stockholm (Sweden). 1988. 86p. Order Number DE89776267/JAW. Available from NTIS (US Sales Only), PC A05/MF A01;1.

This report depicts the work of the International Energy Agency's Experts Group on Heat Meters (EG) from 1984 to 1988. The EG has especially concentrated on the problems of heat metering for small consumers. The Group has organized several studies on heat metering, the results of which are briefly presented in this report. There is a complete report available from every study. The results show that the group's targets have been in the right direction. Heat metering for small consumers continues to be one of the most difficult tasks of energy metering. Technological progress, combined with R and D increase the possibilities of solving this problem. Technical developments will be continued, and we believe that the EG's work so far has made a significant contribution to the effort of improving heat metering for small dwellings in district heating plants.

33775 (STEV–1988-R16) **IAE District Heating. Summary of research activities 1983-1987.** Statens Energiverk, Stockholm (Sweden). 1988. 71p. Order Number DE89776268/JAW. Available from NTIS (US Sales Only), PC A04/MF A01;1.

The National Energy Administration, Sweden, has been the Operating Agent for the first phase, in which the following technical areas have been assessed: development of heat meters; cost efficient distribution; heat production, including small size coal-fired hot water boiler and combined heat and power; use of low temperature heat sources in district heating systems; and conversion of building heating systems to district heating. The report now published is a summary of all research activities carried out in the first phase in the time period between November 1983 and December 1987. The total budget for this first phase has been US-dollar 525000.

33776 (SVF–315) **Foam quality by low ambient temperatures and varying tube temperatures.** Ljungqvist, J. Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden); Studsvik Energiteknik AB, Nykoeping (Sweden). Oct 1988. 71p. (In Swedish). (STUDSVIK-ED–87-34). Order Number DE89776243/JAW. Available from NTIS (US Sales Only), PC A04/MF A01;1.

The report described a laboratory test series for examination of the conditions where a foaming of district heating PEH jacket pipe joints can be done in field at low ambient temperatures. The results show that the chosen amount and temperature of the PUR-foam gives a quality which, in general, approves with the Swedish District Heating Associations 'Tecnical Regulations for Delivery Approval' regarding PUR-foam material parameters such as density, water absorption, closed cells and pressure strength. However, the results foam the visual check of the foam show that the foaming did not result in a homogenous foam with a clean surface structure, free from smears as expected. These results could be an indication of the need for an additional test. This test should be one on the stability of the material parameters over a certain time at various temperatures. The results show that foam components with a temperature of 24 degree C and a mass to give a calculated foam density of 85 kg/m^3 will give a foam of good quality over a wide range of ambient temperatures.

33777 (SVF–318) **Lower operating temperatures in district heating networks - consequences on the distribution system.** Molin, J.; Nilsson, R.; Bergstroem, H. Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden). Oct 1988. 70p. (In Swedish). Order Number DE89776245/JAW. Available from NTIS (US Sales Only), PC A04/MF A01;1.

This report shows that lowered operating temperatures has most important influence on district heating networks with cellular concrete as thermal insulation. Here the drying process after drowning of the culvert is substantially prolonged. The ventilation of these old types of culvert is very seldom in order. For other types of thermal insulation, as mineral wool and polyurethan, the chemical degradation in presence of water and heat is faster at high temperatures than at low temperatures. In this case a lower temperature is favourable and decreases the risk of chemical attack on the steelpipe. A lower operating temperature has not been found to have any negative influence on pipes with polyurethan as thermal insulation. This is the most frequently used type of insulation on pipes for district heating purposes in Sweden nowadays. (With 18 refs.) (authors).

33778 **Biofuels and municipal waste technology a national perspective.** Walter, D.K. (Conservation and Renewable Energy, U.S. Dept. of Energy, Washington, DC (US)). v.v of Energy from biomass and wastes XI. Klass, D.L. Institute of Gas Technology, Chicago, IL (1988). (CONF-870364–: 11. IGT conference on energy from biomass and wastes, Orlando, Florida, USA, 16-20 Mar 1987).

The United States has faced severe energy disruptions in the past 15 years. The precipitous rise in oil prices in the mid- to late 1970's should not be forgotten. Despite the current decline and stabilization in oil prices, the experts agree that near future holds the promise for steep increases. When those increases will occur is not reliably predicted; however, the major reserves of world oil are held in one of the most volatile areas of the world, the Middle East. The current situation should be viewed as the lull that permits the orderly development of new technology that will replace oil in the future. Of the renewable systems, biofuels have the only promise to directly produce liquid transportation fuels. In addition, it is the only renewable source of natural and other fuel gases. Whether viewed from the perspective of national defense (as a domestic, renewable, dispersible feedstock), national economy (as a source of competitive domestic fuels), technology (as a feedstock with many advantages over competitive systems) or markets (as a local system providing new uses for land and conversion) facilities, biofuels are important elements in the Nation's energy mix. Further, biofuels are important for today's supply of steam and electricity as well as for the future supply of liquid and gaseous fuels.

33 ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

3301 Internal Combustion Engines

Refer also to citation(s) 33125, 33202, 33205, 33363, 33365, 34714

33779 (AD-A–201292/0/XAB) **In-line wear monitor. Interim report, November 1985-June 1988.** Pieper, K.A.; Taylor, I.J. General Motors Corp., Indianapolis, IN (USA). Allison Gas Turbine Div. Sep 1988. 68p. (DDA-EDR–13632). Available from NTIS, PC A04/MF A01.

This report describes the construction and test results of an in-line monitor for critical ferrous and nonferrous metal debris in turbine-engine lubrication systems. The in-line wear monitor (ILWM) is being developed by Allison Gas Turbine Division and a subcontractor, Princeton Gamma-Tech. The system uses the x-ray fluorescence principle for detecting metal debris on a continuous basis while the engine is running. The sensor portion of the system is engine mounted and contains a radioactive x-ray source, a flow cell to direct the oil across an x-ray permeable window, a proportional counter x-ray detector and its associated preamplifier and amplifier electronics. The data-acquisition electronics is mounted on the airframe and contains a microprocessor based system for inputting pulses from the sensor, classifying and counting them according to energy bands, and analyzing the data and outputting metal concentration values to the engine monitoring system.

33780 (DOE/MC/23258–2693) **Combustion characteristics of dry coal-powder-fueled adiabatic diesel engine: Final report.** Kakwani, R.M.; Kamo, R. Adiabatics, Inc., Columbus, IN (USA). Jan

1989. 84p. Sponsored by DOE Fossil Energy. DOE Contract AC21-86MC23258. Order Number DE89000978/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

This report describes the progress and findings of a research program aimed at investigating the combustion characteristics of dry coal powder fueled diesel engine. During this program, significant achievements were made in overcoming many problems facing the coal-powder-fueled engine. The Thermal Ignition Combustion System (TICS) concept was used to enhance the combustion of coal powder fuel. The major coal-fueled engine test results and accomplishments are as follows: design, fabrication and engine testing of improved coal feed system for fumigation of coal powder to the intake air; design, fabrication and engine testing of the TICS chamber made from a superalloy material (Hastelloy X); design, fabrication and engine testing of wear resistant chrome oxide ceramic coated piston rings and cylinder liner; lubrication system was improved to separate coal particles from the contaminated lubricating oil; control of the ignition timing of fumigated coal powder by utilizing exhaust gas recirculation (EGR) and variable TICS chamber temperature; coal-fueled engine testing was conducted in two configurations: dual fuel (with diesel pilot) and 100% coal-fueled engine without diesel pilot or heated intake air; cold starting of the 100% coal-powder-fueled engine with a glow plug; and coal-fueled-engine was operated from 800 to 1800 rpm speed and idle to full load engine conditions.

33781 (PB–89-117865/XAB) **Application for certification, 1989 model year light-duty vehicles - Mitsubishi Motors Corporation.** Mitsubishi Motors Corp., Tokyo (Japan). 1989. 599p. Available from NTISPC$75.00/MF$17.00.

See also PB–89-117873, and PB–88-125125; Also available in set of 11 reports PC E99/MF E99, PB–89-117857.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles, or heavy-duty engines submits to EPA an application for certification. In the application, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. These engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. It also provides information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. Section 16 of the application contains the results of emission testing, a statement of compliance to the regulations, production engine parameters, and a Summary Sheet Input Form on which issuance of Certificate of Conformity is based.

33782 (PB–89-117873/XAB) **Application for certification, 1989 model year light-duty vehicles - Ford Motor Company.** Ford Motor Co., Dearborn, MI (USA). 1989. 2074p. Available from NTISPC$232.50/MF$24.50.

See also PB–89-117865, PB–89-117881, and PB–88-125059; Also available in set of 11 reports PC E99/MF E99, PB–89-117857.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles, or heavy-duty engines submits to EPA an application for certification. In the application, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. These engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. It also provides information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. Section 16 of the application contains the results of emission testing, a statement of compliance to the regulations, production engine parameters, and a Summary Sheet Input Form on which issuance of a Certificate of Conformity is based.

33783 (PB–89-117881/XAB) **Application for certification, 1989 model year light-duty vehicles - American Honda Motor Company.** American Honda Motor Co., Inc., Gardena, CA (USA). 1989. 584p. Available from NTISPC$73.50/MF$17.00.

See also PB–89-117873, PB–89-117899, and PB–88-125067; Also available in set of 11 reports PC E99/MF E99, PB–89-117857.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles, or heavy-duty engines submits to EPA an application for certification. In the application, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. These engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. It also provides information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. Section 16 of the application contains the results of emission testing, a statement of compliance to the regulations, production engine parameters, and a Summary Sheet Input Form on which issuance of a Certificate of Conformity is based.

33784 (PB–89-117899/XAB) **Application for certification, 1989 model year light-duty vehicles - US Technical Research Company (Peugeot).** U.S. Technical Research Co. (Peugeot), Lyndhurst, NJ (USA). 1989. 1632p. Available from NTISPC$41.50/MF$22.50.

See also PB–89-117881, PB–89-117907, and PB–89-125091; Also available in set of 11 reports PC E99/MF E99, PB–89-117857.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles, or heavy-duty engines submits to EPA an application for certification. In the application, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. These engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. It also provides information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. Section 16 of the application contains the results of emission testing, a statement of compliance to the regulations, production engine parameters, and a Summary Sheet Input Form on which issuance of a Certificate of Conformity is based.

33785 (PB–89-117907/XAB) **Application for certification, 1989 model year light-duty vehicles - General Motors.** General Motors Proving Ground, Milford, MI (USA). 1989. 2240p. Available from NTISPC$249.50/MF$25.50.

See also PB–89-117899, PB–89-117915, and PB–88-198221; Also available in set of 11 reports PC E99/MF E99, PB–89-117857.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles, or heavy-duty engines submits to EPA an application for certification. In the application, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. These engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. It also provides information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. Section 16 of the application contains the results of emission testing, a statement of compliance to the regulations, production engine parameters, and a Summary Sheet Input Form on which issuance of a Certificate of Conformity is based.

33786 (PB–89-117915/XAB) **Application for certification, 1989 model year light-duty vehicles - Volkswagen.** Volkswagen of America, Inc., Ann Arbor, MI (USA). 1989. 1545p. Available from NTISPC$180.00/MF$22.00.

See also PB–89-117907, PB–89-117923, and PB–88-198254; Also available in set of 11 reports PC E99/MF E99, PB–89-117857.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles, or heavy-duty engines submits to EPA an application for certification. In the application, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. These engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. It also

provides information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. Section 16 of the application contains the results of emission testing, a statement of compliance to the regulations, production engine parameters, and a Summary Sheet Input Form on which issuance of a Certificate of Conformity is based.

33787 (PB–89-117923/XAB) **Application for certification, 1989 model year light-duty vehicles - Mercedes-Benz of North America, Inc.** Mercedes-Benz of North America, Inc., Montvale, NJ (USA). 1989. 491p. Available from NTISPC$64.50/MF$17.00.

See also PB–89-117915, PB–89-117931, and PB–88-125083; Also available in set of 11 reports PC E99/MF E99, PB–89-117857.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles, or heavy-duty engines submits to EPA an application for certification. In the application, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. These engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. It also provides information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. Section 16 of the application contains the results of emission testing, a statement of compliance to the regulations, production engine parameters, and a Summary Sheet Input Form on which issuance of a Certificate of Conformity is based.

33788 (PB–89-117931/XAB) **Application for certification, 1989 model year light-duty vehicles - Volvo Cars of North America.** Volvo of America Corp., Rockleigh, NJ (USA). 1989. 1152p. Available from NTISPC$130.50/MF$19.50.

See also PB–89-117923, PB–89-117949, and PB–88-125133; Also available in set of 11 reports PC E99/MF E99, PB–89-117857.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles, or heavy-duty engines submits to EPA an application for certification. In the application, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. These engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. It also provides information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. Section 16 of the application contains the results of emission testing, a statement of compliance to the regulations, production engine parameters, and a Summary Sheet Input Form on which issuance of a Certificate of Conformity is based.

33789 (PB–89-117949/XAB) **Application for certification, 1989 model year light-duty vehicles - Audi.** V.A.G. Audi, Neckarsulm (Germany, F.R.). 1989. 1070p. Available from NTISPC$122.00/MF$19.50.

See also PB–89-117931, PB–89-117956, and PB–88-198254; Also available in set of 11 reports PC E99/MF E99, PB–89-117857.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles, or heavy-duty engines submits to EPA an application for certification. In the application, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. These engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. It also provides information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. Section 16 of the application contains the results of emission testing, a statement of compliance to the regulations, production engine parameters, and a Summary Sheet Input Form on which issuance of a Certificate of Conformity is based.

33790 (PB–89-117956/XAB) **Application for certification, 1989 model year light-duty trucks - Range Rover.** Range Rover of North America, Inc., Lanham, MD (USA). 1989. 119p. Available from NTISPC$27.00/MF$17.00.

See also PB–89-117949, PB–89-117964, and PB–88-125141; Also available in set of 11 reports PC E99/MF E99, PB–89-117857.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles, or heavy-duty engines submits to EPA an application for certification. In the application, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. These engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. It also provides information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. Section 16 of the application contains the results of emission testing, a statement of compliance to the regulations, production engine parameters, and a Summary Sheet Input Form on which issuance of a Certificate of Conformity is based.

33791 (PB–89-117964/XAB) **Application for certification, 1989 model year light-duty vehicles - Mazda Motor Corporation.** Mazda Motor Corp., Hiroshima (Japan). 1989. 950p. Available from NTISPC$110.50/MF$18.50.

See also PB–89-117956, and PB–88-125075; Also available in set of 11 reports PC E99/MF E99, PB–89-117857.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles, or heavy-duty engines submits to EPA an application for certification. In the application, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. These engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. It also provides information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. Section 16 of the application contains the results of emission testing, a statement of compliance to the regulations, production engine parameters, and a Summary Sheet Input Form on which issuance of a Certificate of Conformity is based.

33792 (PB–89-117980/XAB) **Application for certification, 1989 model year heavy-duty vehicles - Mitsubishi.** Mitsubishi Motors Corp., Tokyo (Japan). 1989. 124p. Available from NTISPC$27.50/MF$17.00.

See also PB–89-117998, and PB–88-198320; Also available in set of 2 reports PC E99/MF E99, PB–89-117972.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles, or heavy-duty engines submits to EPA an application for certification. In the application, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. These engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. It also provides information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. Section 16 of the application contains the results of emission testing, a statement of compliance to the regulations, production engine parameters, and a Summary Sheet Input Form on which issuance of a Certificate of Conformity is based.

33793 (PB–89-117998/XAB) **Application for certification, 1989 model year heavy-duty diesel engines - Hino Motors.** Hino Motors (USA), Inc., New York, NY (USA). 1989. 225p. Available from NTISPC$38.00/MF$17.00.

See also PB–89-117980, and PB–88-125190; Also available in set of 2 reports PC E99/MF E99, PB–89-117972.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles, or heavy-duty engines submits to EPA an application for certification. In the application, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. These engineering data include explanations and/or drawings which describe engine/vehicle

parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. It also provides information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. Section 16 of the application contains the results of emission testing, a statement of compliance to the regulations, production engine parameters, and a Summary Sheet Input Form on which issuance of a Certificate of Conformity is based.

33794 (PB–89-138663/XAB) **Resistively heated metal monolith as a cold start assist for a methanol engine. Interim report. Technical report.** Piotrowski, G.K. Environmental Protection Agency, Ann Arbor, MI (USA). Dec 1988. 21p. (EPA/AA/CTAB–88/11). Available from NTIS, PC A03/MF A01.

Light-duty M100 neat methanol-fueled engines are difficult to start and run in cold weather because of the high boiling point of methanol, methanol's high heat of vaporization (5.5% of the heat of combustion compared to less than 1% for gasoline), and the increased fuel flow needed for methanol. Gasoline-fueled engines start with less difficulty under the same conditions partly because of the easily ignitable light ends of this fuel such as butanes, which are vaporized at relatively low temperatures. The goal of the project was to construct and test a methanol dissociation system that could provide hydrogen and carbon monoxide gaseous fuels in quantities that could be used as a cold start assist for a methanol-fueled engine. This dissociator would utilize resistively heated metal foil technology to provide the energy necessary to bring the catalyst to operating temperatures quickly.

3303 Electric-powered Systems

Refer also to citation(s) 33613

3304 Hybrid Systems

Refer also to citation(s) 33613

3306 Vehicle Design Factors

33795 (SNV–3461) **Investigation of a particle strainer of wall-flow type.** Graegg, K.; Egebaeck, K.E. National Swedish Environmental Protection Board, Solna (Sweden). Apr 1988. 49p. (In Swedish). Order Number DE89776227/JAW. Available from NTIS (US Sales Only), PC A03/MF A01;1.

Three strainers studied of two different cell densities and two different coatings, non-nobel metal coating and nobel metal coating plus non-nobel metal coating. (O.S.).

33796 (STU–83-5812) **Articulated bus with pressure accumulator and two-axle drive possibility.** Larsson, I. Swedish National Board for Technical Development, Stockholm (Sweden). 18 Dec 1987. 36p. (In Swedish). Order Number DE89776225/JAW. Available from NTIS (US Sales Only), PC A03/MF A01;1.

An articulated test bus with a hydraulic auxiliary system has been developed. The system recovers and stores deceleration energy, which may be utilized by start and propulsion of the bus. By this arrangement fuel consumption and with that exhaust gas emission will decrease. The system is connected to the earlier non-drive middle axle in a way permitting drive also on this axle. The so obtained 2-axle drive will improve passability on slipping road. A specially developed control system guides the diesel engine to support the hydraulic system so as to obtain a performance equivalent to that of a standard three-axle bus. The control system also sees that maximum deceleration energy is recovered, by reducing the breaking action of the diesel engine to a minimum. (O.S.).

3307 Emission Control

Refer also to citation(s) 33781, 33782, 33783, 33784, 33785, 33786, 33787, 33788, 33789, 33790, 33791, 33792, 33793

33797 (PB–89-138671/XAB) **Formaldehyde sampling from automobile exhaust: a hardware approach. Technical report.** Pidgeon, W.M. Environmental Protection Agency, Ann Arbor, MI (USA). 7 Jul 1988. 22p. (EPA/AA/TEB–88/01). Available from NTIS, PC A03/MF A01.

Formaldehyde emissions-sampling hardware became an issue with the Environmental Protection Agency's (EPA) release of a Notice of Proposed Rulemaking (NPRM) for Methanol-Fueled Vehicles and Engines. This report discusses a formaldehyde-sampling system that EPA's Emission Control Technology Division, Test and Evaluation Branch (TEB) will use for tests of light-duty vehicles. It also discusses the considerations involved in selecting the specific hardware used to meet TEB's needs. The purpose of the report is to provide information on one approach for sampling formaldehyde emissions and to explain why the approach was taken.

33798 (PB–89-139497/XAB) **Controlling transit-bus emissions and improving management.** Kaplan, E.W.; Andrle, S.J.; Santini, D.J.; Schiavone, J.J.; Small, K.A. National Research Council, Washington, DC (USA). Transportation Research Board. 1988. 68p. (TRB/TRR–1164). Available from NTIS, PC A04/MF A01.

Library of Congress catalog card no. 88-31305.

The 8 papers in the report deal with the following areas: Introduction to diesel particulate emissions, alternative fuels, and the transit industry; Technical problems and policy issues associated with the 1991 bus emissions standards; Reducing transit bus emissions: comparative costs and benefits of methanol, particulate traps, and fuel modification; Effects of applying emissions averaging, trading, and banking to transit buses; Strategic review of heavy-duty engine emission regulations and alternate fuels; Meeting bus emissions standards–a perspective; Economic evaluation of bus maintenance contracting; Objectives for a transit-bus-fleet management data, information, and knowledge exchange.

33799 (PB–89-139752/XAB) **Proposed organic emission standards and test procedures for 1988 and later methanol vehicles and engines.** Environmental Protection Agency, Ann Arbor, MI (USA). Office of Mobile Sources. Jul 1986. 112p. Available from NTIS, PC A06/MF A01.

See also PB–88-169115.

The results of analyses conducted in support of the proposed standards for emissions from methanol-fueled vehicles and motor vehicle engines are summarized in the document. (51 FR 30984, August 29, 1986). The analyses include selection of standards for emissions of methanol and formaldehyde based on non-ozone-related health effects, microscale exposure scenarios, measurement of methanol concentrations and consideration of the costs and benefits of the proposed action as well as a comparison of the proposed action with alternative regulatory approaches. Inclusion of methanol-fueled vehicles and engines in the diesel-particulate-averaging programs is also included.

3308 Alternative Fuels

Refer also to citation(s) 33125, 33202, 33205, 33354, 33362, 33363, 33364, 33365, 33794, 33797, 33798

35 ARMS CONTROL

33800 (LA-UR–89-1000) **Los Alamos Science, No. 17, 1989.** Cooper, N.G.; Eckhardt, R. (eds.). Los Alamos National Lab., NM (USA). 1989. 67p. Sponsored by DOE Defense Programs. DOE Contract W-7405-ENG-36. Order Number DE89012870/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

This issue of Los Alamos Science contains information about the future of nuclear weapons and current research on conventional weapons. (JF)

3501 Policy, Negotiations, and Legislation

33801 (INIS-mf–11428) **United Nations General Assembly and Disarmament 1987.** United Nations, New York, NY (USA). Dept. for Disarmament Affairs. 1988. 184p. Order Number DE89618365/JAW. Available from NTIS (US Sales Only), PC A09/MF A01 - OSTI; INIS.

The report offers a summary of the proposals made and action taken on disarmament issues by the Assembly at its forty-second

regular session. It is published in the framework of the World Disarmament Campaign, which was launched by a unanimous decision of the Assembly in 1982 to inform, to educate and to generate public understanding and support for the objectives of the United Nations in the field of disarmament.

33802 In pursuit of consensus. Deutch, J.M. (Dept. of Energy (US)). v.v of Proceedings of the ANS executive conference on international nuclear commerce. American Nuclear Society, La Grange Park, IL (1980). (CONF-7909284–: American Nuclear Society executive conference on international nuclear commerce, New Orleans, Louisiana, USA, 9-11 Sep 1979).

It is clear that it is not possible to foster a productive atmosphere for international nuclear commerce until we are able to reach a national consensus within this country. The first and most basic element in this equation is the creation of a national understanding that nuclear power is now an essential and necessary part of our energy supply mix and will continue to be so well into the next century. Even with the most optimistic projections for conservation, solar energy and the increased utilization of coal, nuclear power will be necessary if we are to sustain a healthy economic system. Secondly, it is absolutely essential to ensure that reactors which are operating or under construction are as safe and as efficient as possible. While nuclear power has a waste disposal problem, it also has significant environmental advantages over coal-fired plants. The public should be aware that nuclear power is economically viable today. It should also be known that in addition to solar and fusion, nuclear power is a virtually inexhaustible resource. But in making these points, we must also caution against causing polarization in the society by advocating one energy source above another. We need to burn more coal, to install more solar capacity, to produce more domestic oil and to build more nuclear plants in order to reduce our need for imported oil. That is the message we must relay to the American people and to the world.

3502 Proliferation

33803 (AD-A–201669/9/XAB) **Canada: the decision to procure nuclear-attack submarines and its significance for NATO. Master's thesis.** Guillory, T. Naval Postgraduate School, Monterey, CA (USA). Sep 1988. 99p. Available from NTIS, PC A05/MF A01.

In June 1987 the Canadian government announced plans to procure 10 to 12 nuclear attack submarines (SSNs). The evidence suggests that, for some Canadians, a primary purpose for this submarine program may not be to enhance the security of NATO, but instead to assert Canada's sovereignty, principally against the United States, in the Arctic region. The thesis discusses this decision and its possible implications for the security of North America and NATO. It is argued that the United States must continue to have unimpeded access to the Arctic region to counter the ever-increasing threat posed by Soviet nuclear ballistic missile submarines (SSBNs). Finally, the thesis suggests a possible solution to the current sovereignty debate and a potential strategy for employing these SNN to enhance the security of North America and NATO as a whole.

36 MATERIALS

33804 (DOE/ER/01198–T14, pp. 195-200) **Council on materials science.** Flynn, C.P. Illinois Univ., Urbana, IL (USA). Materials Research Lab. Mar 1988. In *Materials Research Laboratory: Renewal proposal for the extension in time and funds.* Order Number DE88013776/JAW. Available from NTIS, PC A99/MF A01; 1.

The primary objective of the Council on Materials Science is to act as a discussion forum for the DOE Division of Materials Science on matters affecting research trends, and to assist in the transfer of relevant information from the research community to DOE and other federal agencies. Panel Workshops conducted since 1980 are as follows: Non-Destructive Evaluation of Materials, 1980, J.A. Krumhansl and James Gubernatis, Co-Chmn; Effects of Irradiation in the Structure and Properties of Materials, 1981, C.P. Flynn, Chmn; Future Trends in Condensed Matter Theory and the Role and Support of Computation, 1981, J.D. Joannopoulos and A.H. Becker, Co-Chmn; Scientific needs of the Technology for Nuclear Waste Containment, 1982, David Turnbull, Chmn; High Pressure Science and Technology, 1982, George Samara, Chmn; Coatings and Surface Modification, 1983, Richard Schwoebel, Chmn; Synthesis of Organic Electronic Materials, 1983, Aaron Bloch, Chmn; Materials Synthesis and Processing, 1984, L. Testardi and T. Coyle, Co-Chmn; Theory and Computer Simulation of Materials Structures and Imperfections, 1984, A.B. Kunz, Chmn; Bonding and Adhesions at Interfaces, J. Smith, Chmn; Micromechanics of Fracture in Metallic Materials, 1985, V. Vitek, Chmn; Facilities for Electron Microscopy, 1985, H.K. Birnbaum, Chmn; Facilities for Neutron scattering, 1986, P. Pincus, Chmn; Molecular Thin Films, 1986, J. Swalen, Chmn; Nanophase Materials 1987, R. Seigel and L. Brus, Co-Chmn; Facilities for Synchrotron Radiation, 1987, M.J. Cardillo, Chmn.

3601 Metals and Alloys

Refer also to citation(s) 33139, 33318, 33319, 33320, 33322, 33323, 33342, 33443, 33444, 33458, 33477, 33484, 33493, 33500, 33514, 33518, 33535, 33536, 33537, 33538, 33581, 33626, 33692, 33694, 33706, 33948, 33965, 34035, 34116, 34190, 34191, 34192, 34193, 34197, 34198, 34200, 34201, 34206, 35442

33805 (AD-A–201484/3/XAB) **To measure and characterize metal corrosion in electrolyte solutions by exploiting the properties of superconductors. Final technical report.** MacVicar, M.L. Massachusetts Inst. of Tech., Cambridge, MA (USA). 30 Aug 1988. 173p. Available from NTIS, PC A08/MF A01.

A framework relating fluctuations in an electrochemical cell to fluctuations of the fundamental thermodynamic and kinetic parameters of the system is presented. A method for extracting critical interface parameters via noise measurements, such as the charge-transfer resistance, is developed. The technique, called variable load analysis, does not require perturbation of the cell with applied voltage or current. The framework suggests measurements to distinguish between different noise sources superimposed in the same signal, and to determine the mechanisms underlying the observed noise. A cell geometry with two identical electrodes connected through an external resistive load is used. Fluctuations in the current flowing between the two electrodes under open circuit conditions (i.e. under no applied external potential) provide the detected signal.

33806 (AD-A–201526/1/XAB) **Pulsed electrodeposition of Ni-Mo alloys.** Nee, C.C.; Kim, W.; Weil, R. Stevens Inst. of Tech., Hoboken, NJ (USA). May 1988. 4p. Available from NTIS, PC A02/MF A01.

Pub. in Jnl. of the Electrochemical Society, Vol. 135, No. 5, 1100-1103(May 1988).

The effect of pulsing the current on the composition, internal stress, and mechanical properties of Ni-Mo electrodeposits was investigated. The molybdenum content increased with increasing peak current density and to a lesser degree with decreasing duty cycle. A reduction in the internal stresses was explained in terms of the relaxation of those due to crystallite or fine grain coalescence during the off-time and an expansion of the surface layer when hydrogen diffused into it at the start of each on-time. The mechanical properties were improved by high-frequency pulse plating. Deposits consisting of alternate layers of different composition annealed at 300 C exhibited further improvement of their mechanical properties.

33807 (AERE-R–13380) **Corrosion and environmental effects on materials. UKAEA conference on materials analysis by physical techniques, Northern Research Laboratories (Risley), 4-5 October 1988.** Bellamy, B.A. (ed.). UKAEA Harwell Lab. (UK). Materials Development Div. Jan 1989. 21p. (CONF-8810380–: Conference on materials analysis by physical techniques, Risley, UK, 4-5 Oct 1988). Available from H.M. Stationery Office, London, price Pound 8.00.

This report is a collation of the abstracts of the 18 papers presented to the Conference. Many aspects of corrosion and environmental effects were highlighted together with the characterisation of the effects by a wide range of physical analytical techniques.

33808 (BNL–42692) **Effects of high thermal and high fast fluences on the mechanical properties of type 6061 aluminum in the HFBR.** Weeks, J.R.; Czajkowski, C.J.; Tichler, P.R. Brookhaven National Lab., Upton, NY (USA). 1988. 25p. Sponsored

by DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-880613–32: 14. international symposium on effects of radiation on materials, Andover, Massachusetts, USA, 27-29 Jun 1988). Order Number DE89012636/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The High Flux Beam Reactor (HFBR) at Brookhaven National Laboratory (BNL) is an epithermal, externally moderated (by D_2O) facility designed to produce neutron beams for research. Type 6061 T-6 aluminum was used for the beam tubes, pressure vessel, fuel cladding, and most other components in the high flux area. The HFBR has operated since 1965. The epithermal, external moderation of the HFBR means that materials irradiated in different areas of the facility receive widely different flux spectra. Thus, specimens from a control rod drive follower tube (CRDF) have received 1.5×10^{22} n/cm^2 (E > 0.1 MeV) and 3.2×10^{23} n/cm^2 thermal fluence, while those from a vertical thimble flow shroud received 1.9×10^{23} n/cm^2 (E > 0.1 MeV) and 1.0×10^{23} n/cm^2 thermal. These numbers correspond to fast to thermal fluence ratios ranging from 0.05 to 1.9. Irradiations are occurring at approximately 333°K. The data indicate that the increase in tensile strength and decrease in ductility result primarily from the thermal fluence, i.e., the transmutation of aluminum to silicon. These effects appear to be saturating at fluences above approximately 1.8×10^{23} n/cm^2 thermal at values of 90,000 psi (6700 Kg/mm^2) and 9%, respectively. The specimens receiving the highest fluence ratios appear to have less increase in tensile strength and less decrease in ductility than specimens with a lower fast to thermal fluence ratio and the same thermal fluence, suggesting a possible beneficial effect of the high energy neutrons in preventing formation of silicon crystallites. 7 refs., 11 figs., 3 tabs.

33809 (CONF-890426–20) **Magneto-optical properties of ultrathin ferromagnetic films.** Bader, S.D.; Moog, E.R.; Liu, C.; Zak, J. Argonne National Lab., IL (USA). Apr 1989. 11p. Sponsored by DOE Energy Research. DOE Contract W-31109-ENG-38. From Spring meeting of the Materials Research Society; San Diego, California, USA; 24-28 Apr 1989. Order Number DE89014640/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The surface magneto-optic Kerr effect (SMOKE) has been used to explore the properties of ultrathin ferromagnetic films. The ultrathin regime corresponds to thicknesses less than the depth penetration of light and includes the monolayer range. The ultrathin regime possesses unique magneto-optic properties: the Kerr rotation and ellipticity, in general, behave differently than in the thick film limit. Measurements and simulation in the longitudinal geometry for bcc Fe on Au(100) provide a dramatic example of the metallic reflector enhancement effect due to the nonmagnetic Au underlayer. The rotation enhancement is accompanied by a high reflectivity, as opposed to being at the expense of the reflectivity. Measurements in both polar and longitudinal geometries for epitaxially-stabilized fcc Fe films grown on Cu(100) and Pd(100) indicate the presence of perpendicular surface anisotropy, which suggests new approaches to realizing vertical data-storage media. 31 refs., 7 figs.

33810 (CONF-890468–9) **Study of the microstructure of silver films deposited by ion assisted deposition onto aluminum oxide substrates.** Erck, R.A.; Fenske, G.R. Argonne National Lab., IL (USA). 1989. 18p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract W-31109-ENG-38. From 16. international conference on metallurgical coatings and equipment exhibit; San Diego, California, USA; 17-21 Apr 1989. Order Number DE89014665/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Ion-assisted deposition (IAD) can be used to modify the microstructure, density, or other properties of thin films. To understand the effects of ion bombardment on film growth, we studied the film morphology and hardness of evaporated Ag films that had been bombarded by Ar ions during deposition. Cross sections of deposited films were examined by scanning electron microscopy, and film hardness was measured with a diamond indenter. Substantial increases in film porosity and surface roughness were seen in the 1000-eV Ar-ion-bombarded specimens, compared to vapor-deposited specimens or to specimens bombarded with 300 or 150-eV ions. The IAD films generally had hardness values greater than that of evaporated films. Low hardness values were obtained for a porous 1000-eV IAD film; these are attributed to the presence of compressible pores. No Ar was detected in the films. 16 refs., 7 figs., 1 tab.

33811 (CONF-890468–10) **Corrosion behavior of chromized and/or aluminized 9Cr-1Mo steels in medium-BTU coal gasifier environment.** Wang, D. Argonne National Lab., IL (USA). Feb 1989. 19p. Sponsored by DOE Fossil Energy. DOE Contract W-31109-ENG-38. From 16. international conference on metallurgical coatings and equipment exhibit; San Diego, California, USA; 17-21 Apr 1989. Order Number DE89014666/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The corrosion behavior of 9Cr-1Mo steels with chromized and/or aluminized coatings was investigated in a simulated, medium-BTU, coal gasifier environment at 600°C. Those coatings containing aluminide layers were unsuitable for use in coal gasifier atmospheres because of severe cracking during the test, which induced internal sulfidation/oxidation of the base materials. Excellent corrosion protection was provided by a chromized coating, which successfully blocked the inward diffusion of sulfur and oxygen. 10 refs., 8 figs.

33812 (CONF-890721–9) **Rate-sensitivity and short term relaxation behavior of AISI Type 304 stainless steel at room temperature and at 650°C; influence of prior aging.** Ruggles, M.B.; Krempl, E. Oak Ridge National Lab., TN (USA). 1989. 25p. Sponsored by DOE Energy Research. DOE Contract AC05-84OR21400. From Joint ASME/JSME pressure vessel and piping conference; Honolulu, Hawaii, USA; 23-27 Jul 1989. Order Number DE89007823/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The strain rate sensitivity and short term relaxation behavior of Type 304 Stainless Steel were investigated in the uniaxial strain rate jump tests with intermittent periods of relaxation at room temperature and at 650°C. At room temperature material exhibited conventional strain rate sensitivity and no strain rate history effect. The high-temperature experimental results revealed a complex and dramatically different material behavior. At 650°C the pattern of strain rate sensitivity was not set as soon as the plastic flow was fully established, but continued to evolve with the further straining in the plastic range. Test results indicate that at 650°C the material may exhibit a strain rate history effect. Both at room temperature and at 650°C the relaxation behavior was independent of the stress and/or strain level at the beginning of the relaxation, but depended nonlinearly on the strain rate preceding the relaxation test. Prior aging had no significant influence on the rate-dependent material response. The irregular material behavior at 650°C is attributed to dynamic strain aging as indicated by serrated stress-strain curves (the Portevin-LeChatelier effect). 20 refs., 9 figs., 1 tab.

33813 (CONF-890748–3) **Loss of grain boundary segregant during ion milling.** Kenik, E.A. Oak Ridge National Lab., TN (USA). 1989. 7p. Sponsored by DOE Energy Research. DOE Contract AC05-84OR21400. From Microbeam Analysis Society meeting; Asheville, North Carolina, USA; 16-21 Jul 1989. Order Number DE89007835/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Bismuth segregates to grain boundaries in copper at intermediate temperatures (400–800°C). Currently, x-ray microanalysis is being used to measure the degree of equilibrium segregation as a function of boundary character. As part of that study, transmission electron microscopy specimens were prepared by several techniques in order to select that method which produced optimum specimens. Electropolishing produced specimens of marginal quality because of preferential grain boundary attack. On the other hand, ion-milling produced good, thin specimens with little or no boundary attack. However, x-ray microanalysis on specimens ion-milled at room temperature indicated no bismuth segregation, whereas analysis on electropolished specimens indicated bismuth segregation. A loss of bismuth from the ion-milled specimens was proposed to result from the high vapor pressure of bismuth at slightly elevated temperatures. The use of a liquid nitrogen cold stage during ion-milling minimizes the loss of bismuth. It is likely that beam heating during ion-milling is a contributing factor in this process and must be controlled. 9 refs., 3 figs.

33814 (CONF-8706387–) **Proceedings of the JOWOG 22C (uranium) meeting.** Nelson, T.; Talaber, C.; Wood, D.H. (eds.).

Lawrence Livermore National Lab., CA (USA). 1987. 542p. Sponsored by DOE Defense Programs. DOE Contract W-7405-ENG-48. From 22. JOWOG meeting; Livermore, California, USA; 9-11 Jun 1987. Order Number DE89013004/JAW. Available from NTIS, PC A22/MF A01 - OSTI.

Lawrence Livermore National Laboratory was pleased to be host to the JOWOG 22C Meeting on June 9-11, 1987. This meeting was one of a continuing series on the subject of uranium and uranium alloys held between representatives of the United Kingdom and the United States under a treaty signed July 3, 1958. These, and similar meetings on other subjects, are controlled by the Department of Energy and the Joint Atomic Information Exchange Group (a combined agency of the Departments of Energy and Defense). The following topics were covered in the meeting: Use of Computers to Simulate Uranium; Corrosion and Chemical Stability; Superplasticity; Bonding, Corrosion, Etc.; Thermomechanical Properties and Fabrication; U-Ti Alloys; Uranium-Niobium Alloys; Physical Metallurgy and Testing; Miscellaneous Subjects; and Production and Facilities/Production Technology.

33815 (CONF-8810170–, pp. 311-327) **Overview of the advanced research and technology development fossil energy materials program.** Judkins, R.R. (Oak Ridge National Lab., TN (USA)). USDOE Pittsburgh Energy Technology Center, PA (USA). 1988. DOE Contract AC05-84OR21400. From DOE direct liquefaction contractor's conference; Pittsburgh, Pennsylvania, USA; 4-6 Oct 1988. In *Direct liquefaction contractors' review meeting. Proceedings.* Order Number DE89009225/JAW. Available from NTIS, PC A22/MF A01; 1.

The AR & TD Fossil Energy Materials Program is a comprehensive program directed to understanding materials and materials behavior in fossil energy environments. Although it is not directed to specific applications, the program is intended to address in a general way the materials needs of a variety of coal conversion and utilization processes. To maximize the impact of the program on the materials community, three research thrust areas were identified and research was initiated in these three areas. These include structural ceramic composites, alloy development and mechanical properties, and corrosion and erosion of alloys. In addition to the research that is performed, a vigorous effort is made to transfer the developed technology to potential industrial users. Significant accomplishments are discussed for all three programs.

33816 (CONF-8905118–10) **Analysis of microstructural development in single crystal welds.** Rappaz, M.; David, S.A.; Vitek, J.M.; Boatner, L.A. Oak Ridge National Lab., TN (USA). 1989. 5p. Sponsored by DOE Energy Research. DOE Contract AC05-84OR21400. From 2. international conference on trends in welding research; Gatlinburg, Tennessee, USA; 15-19 May 1989. Order Number DE89013537/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A detailed analysis of the dendritic microstructure produced in autogenously welded single crystals Fe-15Ni-15Cr has been performed in order to investigate the relationship between growth crystallography and solidification behavior. From a geometrical analysis relating the dendrite growth velocities to the weld velocity, it has been shown that, at a given point of the melt pool surface, selection of the preferred dendrite trunk growth direction occurs according to a minimum velocity (i.e., minimum undercooling) criterion. Knowing the growth rate of the selected dendrite orientation, the dendrite tip radius and the dendrite trunk spacing have been computed using recent theories of rapid solidification of ternary systems. The predicted dendrite growth orientation and spacing have been successfully compared to experimental observations made on electron beam and laser welds, thus clearly demonstrating the effect of crystallography on the microstructural development during weld pool solidification. 13 refs., 6 figs.

33817 (CONF-8905118–11) **The use of field indentation microprobe in measuring mechanical properties of welds.** Haggag, F.M.; Wong, H.; Alexander, D.J.; Nanstad, R.K. Oak Ridge National Lab., TN (USA). 1989. 7p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC05-84OR21400. From 2. international conference on trends in welding research; Gatlinburg, Tennessee, USA; 15-19 May 1989. Order Number DE89013548/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A field indentation microprobe (FIM) was conceived for evaluating the structural integrity of metallic components (including base metal, welds, and heat-affected zones) in situ in a nondestructive manner. The FIM consists of an automated ball indentation (ABI) unit for determining the mechanical properties (yield strength, flow properties, estimates of fracture toughness, etc.) and a nondestructive evaluation (NDE) unit (consisting of ultrasonic transducers and a video camera) for determining the physical properties such as crack size, material pileup around indentation, and residual stress presence and orientation. The laboratory version used in this work performs only ABI testing. ABI tests were performed on stainless steel base metal (type 316L), heat-affected zone, and welds (type 308). Excellent agreement was obtained between yield strength and flow properties (true-stress/true-plastic-strain curve) measured by the ABI tests and those from uniaxial tensile tests conducted on 308 stainless steel welds, thermally aged at 343°C for different times, and on the base material. 4 refs., 17 figs.

33818 (CONF-8905118–12) **The effect of aging at 343°C on type 308 stainless steel welds.** Alexander, D.J.; Alexander, K.B.; Nanstad, R.K. Oak Ridge National Lab., TN (USA). 1989. 5p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC05-84OR21400. From 2. international conference on trends in welding research; Gatlinburg, Tennessee, USA; 15-19 May 1989. Order Number DE89013545/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Three nominally 25-mm (1-in) thick shielded metal-arc welds were prepared from 304L base plate with 308 filler material, to obtain three different ferrite levels (4, 8, and 12 %). Portions of these welds were then aged at 343°C for 3000, 10000, and 20000 hours. Charpy V-notch and tensile specimens were taken from the welds. The tensile results were similar for all the specimens and showed little effect of aging on either the yield or ultimate tensile strengths. The Charpy impact properties of the higher ferrite content materials were significantly degraded by these agings, with larger decreases in the impact energy with increased aging time. The microstructures of the welds were examined by metallography and transmission electron microscopy, and the fracture surfaces were examined by scanning electron microscopy. The changes in the mechanical properties and the fractography are discussed in light of the observed changes in the microstructure. 3 refs., 3 figs., 2 tabs.

33819 (DOE/ER/01198–T14, pp. 5-17) **Transport processes in localized corrosion.** Alkire, R.C. Illinois Univ., Urbana, IL (USA). Materials Research Lab. Mar 1988. In *Materials Research Laboratory: Renewal proposal for the extension in time and funds.* Order Number DE88013776/JAW. Available from NTIS, PC A99/MF A01; 1.

The purpose of this program is to study localized corrosion processes in which protective surface films are disrupted and then repaired spontaneously. Fluid flow is used as a probe in these studies since, for many systems, the breakdown and repair events are strongly influenced by hydrodynamnic and mass transport processes. Experiments aim for controlled variation of parameters in pristine systems. Mathematical models are used to articulate hypotheses of mechanism. Experimental techniques rely on MRL central facilities. New experimental methods which use ion implantation, focused lasers, and microlithography are being developed for guiding controlled local breakdown of an otherwise passive surface. With these techniques, behavior of individual corrosion sites can be observed. Initiation of corrosion at inclusions and pits is investigated in stationary systems as well as during cyclic fatigue and in flowing systems.

33820 (DOE/ER/01198–T14, pp. 19-33) **Defect, diffusion, and non-equilibrium processing of materials.** Averback, R.S. Illinois Univ., Urbana, IL (USA). Materials Research Lab. Mar 1988. In *Materials Research Laboratory: Renewal proposal for the extension in time and funds.* Order Number DE88013776/JAW. Available from NTIS, PC A99/MF A01; 1.

This research program investigates the kinetics, structure and properties of materials produced by non-equilibrium processing methods. This includes basic studies of point defect properties, diffusion, and phase transformations in metastable states of matter. The major areas of research are: (i) Ion Beam Modifications of Materials: the major issues to be elucidated are the nature of energetic

displacement cascades in different materials, metals, intermetallic compounds and semiconductors; radiation-enhanced diffusion in intermetallic compounds and semiconductors; ion-solid processes in ion beam assisted film growth. (ii) Solid State Reactions and Radiation Effects in Metallic Glasses. (iii) Nanophase Materials: this research investigates kinetic processes diffusion, grain growth, formation of metastable phases and phase transformations in elemental and composite nanophase materials. It also studies the mechanical properties in metallic, ceramic and composite nanophase materials. Relationships between properties and structure are developed. These investigations involve a combination of surface characterization, electron microscopy and x-ray diffraction methods. Radiation effects studies are heavily supported by molecular dynamics computer simulation.

33821 (DOE/ER/01198–T14, pp. 61-73) **Growth and transport at metal and semiconductor interfaces.** Ehrlich, G. Illinois Univ., Urbana, IL (USA). Materials Research Lab. Mar 1988. In *Materials Research Laboratory: Renewal proposal for the extension in time and funds.* Order Number DE88013776/JAW. Available from NTIS, PC A99/MF A01; 1.

Work is underway to characterize the kinetics of processes important in the growth of crystals and metallic overlayers on the atomic level. Initially the process emphasized for quantitative study will be diffusion over flat crystal terraces. The importance of substrate structure, as well as of the chemical identity of the adatoms on diffusion will be explored by using the field ion microscope to reveal the surface with atomic resolution. Atom motion will be studied on bcc metals, such as tungsten or molybdenum, on metals of the platinum family, on hcp materials such as rhenium, as well as on semiconductor surfaces (silicon), in order to establish how the dynamics and energetics of atomic events are affected by surface structure and chemical bonding.

33822 (DOE/ER/01198–T14, pp. 75-92) **Local strain determination at interfaces in metals and semiconductors.** Fraser, H. Illinois Univ., Urbana, IL (USA). Materials Research Lab. Mar 1988. In *Materials Research Laboratory: Renewal proposal for the extension in time and funds.* Order Number DE88013776/JAW. Available from NTIS, PC A99/MF A01; 1.

This project involves the characterization of interfaces in metals and semiconducting materials, and subsequently the relationships between the structure of interfaces and their properties. Currently, the main interest is associated with a determination of the local state of distortion at interfaces. Such determinations lead to a more detailed understanding of the structure of interfaces, and, for example, directly to the misfit between a precipitate and a given matrix. A detailed study of local strains at interfaces in strained-layer superlattices in the Si/(Si-Ge) alloy system has been underway. The development of this project will include metallurgical engineering of these interfaces, specifically alloying aimed at reducing local distortions at interfaces or conversely increasing the Ge content for a given distortion. This work has been extended to interfaces in metallic systems, specifically in Ni-base superalloys possessing a dispersion of Ni_3Al particles in a Ni matrix. In the case of the latter, information on the interfaces between constituent phases is required to understand more fully the behavior of these materials when subjected to exposure at elevated temperatures and/or stresses.

33823 (DOE/ER/01198–T14, pp. 107-129) **Crystal growth and physical properties of single crystal metastable semiconductors.** Greene, J.E. Illinois Univ., Urbana, IL (USA). Materials Research Lab. Mar 1988. In *Materials Research Laboratory: Renewal proposal for the extension in time and funds.* Order Number DE88013776/JAW. Available from NTIS, PC A99/MF A01; 1.

The aim of this project is to investigate the growth kinetics, atomic and electronic structure, vibrational dynamics, physical properties, and structural stability of unique new single-crystal thermodynamically-metastable alloy systems - semiconducting, ceramic, and metallic - that are of potential interest for energy-related applications. A key feature in the growth of many of these materials is the controlled use of low-energy (20-200 eV) ion irradiation of the substrate and growing film to alter nucleation and growth kinetics and provide dynamic ion-mixing during deposition from the vapor phase. In addition to producing new materials with a wider range in achievable properties, the authors have demonstrated that these materials represent a very rich atomic-scale laboratory for investigating and developing new insights into the kinetics of crystal growth, the relationship between electronic and atomic structure, and phase transitions in solids. Materials which are presently under investigation include the $(III\text{-}V)_{1-x}(IV_2)_x$ alloys $(GaAs)_{1-x}(Ge_2)_x$, $(GaSb)_{1-x}(Ge_2)_x$, and $(GaSb)_{1-x}(Ge_{2(1-y)}Sn_{2y})_x$, epitaxial TiN_x (x ranging from 0.6 to overstoichiometric 1.2), B-1 structure $Ti_{1-x}Al_xN$ alloys, TiN/VN strained-layer superlattices, and fcc-structure $Cu_{1-x}Cr_x$ alloys. A combination of optical measurements, XPS, X-ray and electron diffraction, EXAFS, TEM, and Raman scattering have been used to show that the $(III\text{-}V)_{1-x}(IV_2)_x$ alloys, for example, exhibit a very complex structure with essentially perfect short-range order (i.e. no antisite bonds) at all x and a long-range order/disorder transformation near $x \approx 0.3$. Optoelectronic properties are highly non-linear as a function of composition and the Ge-based alloys, in particular, exhibit excellent high-temperature stability. The metastable nitride phases have shown extremely high hardnesses, exc

33824 (DOE/ER/01198–T14, pp. 159-171) **Mechanisms of environmentally induced embrittlement.** Altstetter, C.J. Illinois Univ., Urbana, IL (USA). Materials Research Lab. Mar 1988. In *Materials Research Laboratory: Renewal proposal for the extension in time and funds.* Order Number DE88013776/JAW. Available from NTIS, PC A99/MF A01; 1.

The objective of this program is to examine mechanisms proposed to explain hydrogen-induced slow, sub-critical crack growth in stainless steel alloys. The two mechanisms which are under investigation are applicable to different, overlapping regimes of hydrogen concentration, low and high concentration. The high concentration extreme arises in practice when the metal is exposed to hot aggressive liquid solutions or to high pressure hydrogen gas or hydrogen-containing gases undergoing chemical reaction. The low concentration regime occurs for less aggressive conditions, when the hydrogen fugacity in the environment is smaller. To understand behavior for both concentration ranges it is necessary to carefully characterize the hydrogen distribution and concentration. In an effort to eliminate uncertainties and behavior changes due to high hydrogen concentration gradients and the attendant stress and plastic strains, their experiments are carried out on specimens which are thin enough to approach uniform concentration of hydrogen. In a sense, the authors are attempting to simulate the concentration conditions in the metal at the tip of a propagating crack, so as to minimize kinetic factors and focus on the crack advance mechanisms.

33825 (DOE/ER/01198–T14, pp. 173-193) **Solute effects on mechanical properties of grain boundaries.** Birnbaum, H.K. Illinois Univ., Urbana, IL (USA). Materials Research Lab. Mar 1988. In *Materials Research Laboratory: Renewal proposal for the extension in time and funds.* Order Number DE88013776/JAW. Available from NTIS, PC A99/MF A01; 1.

This research program is focused on developing an understanding of those properties of grain boundaries and interfaces which affect the response of solids to applied stresses. The author is particularly concerned with solute effects on grain boundary and interface structures and with the effects on dislocation behavior in the vicinity of the interfaces. Attention is focused on the plastic response of the materials near the interfaces and on the alternative process of fracture nucleation and propagation. The major issues addressed are: (a) How can the mechanisms of strain transfer across grain boundaries be characterized? What are the mechanisms of fracture nucleation and propagation at grain boundaries? (b) How are these processes influenced by solute segregation and by the presence of aggressive atmospheres such as hydrogen? (c) The effects of solutes on dislocation behavior and on the bonding of atoms at interfaces. The principle methods used will be Environmental Cell T.E.M. techniques combined with in situ straining and fracture methods. Stainless steels, nickel, and aluminum will be investigated (as characteristic metallic systems) as will be the covalently (and partially ionically bonded) systems of GaAs and MgO. Observations of dislocation behavior at interfaces will be correlated with the macroscopic concepts used to describe the intergranular and interfacial fracture.

33826 (DOE/ER/01198–T14, pp. 217-225) **Micromechanics of deformation and fracture.** Leckie, F.A. Illinois Univ., Urbana, IL (USA). Materials Research Lab. Mar 1988. In *Materials Research Laboratory: Renewal proposal for the extension in time and funds.* Order Number DE88013776/JAW. Available from NTIS, PC A99/MF A01; 1.

This program has focused upon the application of micromechanical modeling to the understanding of deformation damage which results from creep, cyclic loading, or from a combination of these loading methods. The approach used is one of describing material behavior by internal state variables and a scalar convex potential from which the strain rate and rate of change of internal state variables can be derived. The program is focused on understanding the bulk mechanisms of damage such as nucleation and growth of voids, precipitate coarsening, and strain softening. Constitutive equations for failure by void growth are developed for distributions of voids and for both creep and fatigue loading. These material models have been applied to structural problems.

33827 (DOE/ER/01198–T14, pp. 227-246) **Mechanical properties of intermetallic compounds.** Loxton, C.; Robertson, I. Illinois Univ., Urbana, IL (USA). Materials Research Lab. Mar 1988. In *Materials Research Laboratory: Renewal proposal for the extension in time and funds.* Order Number DE88013776/JAW. Available from NTIS, PC A99/MF A01; 1.

Most ordered alloys, particularly those with the $L1_2$ (cubic ordered structure), show increasing yield and flow stresses with increasing temperature. As the values of these stresses are very high the alloys are candidates for high-temperature applications and Ni_3Al has received particular attention. While single crystals exhibit high ductility even at low temperatures, the polycrystalline form is susceptible to brittle intergranular fracture and environmentally-induced embrittlement. It has recently been observed, however, that the problem of intergranular fracture can be mitigated by microalloying with B provided that the Al content is below 25 at.%. The reasons for this are, as yet, unknown. To investigate these problems a correlated study of grain boundaries and surfaces is being undertaken with both surface-analysis and TEM techniques. Grain-boundary microchemistry of Ni_3Al alloys is being studied by AES and XPS to determine the segregation thermodynamics of Ni, Al, B, C and S and their chemical state. Deformation and fracture in the vicinity of grain boundaries are being studied by in-situ TEM techniques as a function of the grain-boundary microchemistry. The factors under study are the role of boundaries as barriers to slip, the mechanism by which slip is transferred from one grain to another and the mechanism by which cracks nucleate and propagate along boundaries. Environmental effects on this alloy are also being studied. Particular attention has been focused upon hydrogen embrittlement of Ni_3Al (by TEM techniques) and of their oxidation behavior which may be related to dynamic embrittlement effects (by surface analysis and TEM techniques). Results of these measurements will be related to macroscopic deformation and fracture data.

33828 (DOE/ER/01198–T14, pp. 247-257) **Role of deformation mechanisms in multiaxial hardening and cyclic fatigue.** Socie, D.F. Illinois Univ., Urbana, IL (USA). Materials Research Lab. Mar 1988. In *Materials Research Laboratory: Renewal proposal for the extension in time and funds.* Order Number DE88013776/JAW. Available from NTIS, PC A99/MF A01; 1.

This research program is focused on developing an understanding of the behavior of engineering materials when subjected to complex loading involving high temperatures and multiaxial states of stress. Efforts are directed toward developing macroscopic damage models based on the microscopic damage mechanisms. Damage accumulation is being studied on the macroscopic level by measuring the degradation of mechanical properties and on the microscopic level using TEM. Room temperature studies of multiaxial fatigue damage will be completed and this part of the project will be phased out during this period as the original research goals have been achieved. Studies of multiaxial cyclic hardening will continue. A model for nonproportional cyclic hardening based on changes in the dislocations substructure is being developed. A new effort in the high temperature mechanical properties of ceramics will begin during this period. The growth of damage in Si_3N_4 and SiC under static and cyclic loading will be studied.

33829 (DOE/ER/01198–T14, pp. 259-267) **Micromechanism of fracture.** Stubbins, J.F. Illinois Univ., Urbana, IL (USA). Materials Research Lab. Mar 1988. In *Materials Research Laboratory: Renewal proposal for the extension in time and funds.* Order Number DE88013776/JAW. Available from NTIS, PC A99/MF A01; 1.

The goal of this research project is to develop a basic understanding of the micromechanisms which lead to failure in stressed material at elevated temperature where creep (stress relaxation), fatigue, and environment all contribute to the failure process. Any of these mechanisms could individually induce failure, but when combined they have the potential to vastly accelerate the process. Particular attention is paid to the role of oxide films and their influence on crack initiation and growth, and to the role of corrodant which can intrude into the process zone ahead of the crack tip to accelerate failure. This latter process may alter the generation and mobility of dislocations ahead of the crack, or enhance the formation and growth of creep or plastic voids, either of which affects the failure process. The research program consists of an experimental program in which elevated temperature mechanical testing is carried out in controlled environments. The micromechanisms influencing failure are characterized from failed and interrupted mechanical test specimens with the aid of scanning and transmission electron microscopy and associated microanalytical techniques. This quantitative information is then used as a basis for physical models of the fracture process.

33830 (DOE/ER/01198–T14, pp. 269-281) **Structure and kinetics of ordering in metal alloys and silicide thin films.** Chen, H. Illinois Univ., Urbana, IL (USA). Materials Research Lab. Mar 1988. In *Materials Research Laboratory: Renewal proposal for the extension in time and funds.* Order Number DE88013776/JAW. Available from NTIS, PC A99/MF A01; 1.

The objective of this research is to obtain a fundamental understanding of the kinetics and mechanisms of thermally induced ordering transformations in condensed matter. Earlier work has been concentrated on the devitrification behavior of amorphous silicate glasses. Current interest lies in the precipitation phenomena of Ni-base alloys and the layer growth of silicide thin films. In addition to its intrinsic interest, such information is needed before these materials are used for applications such as high-temperature structural materials and metallization in device industry. The metal-silicides have been utilized as ohmic or Schottky contact between metals and semiconductors. In-situ x-ray diffraction study enables the continuous monitoring of silicide layer growth and subsequent modification of microstructures. X-ray diffraction topography employing both laboratory and synchrotron radiation sources is utilized to correlate microstructural defects in the underlying Si substrates and macroscopic stresses in the silicide films with the formation of metal-silicides layers. Both transitional metal-silicides, e.g., Pd/Si, Ni/Si, and refractory metal-silicides, e.g. Cr/Si, are being investigated with the goal of improving the integrity of thin film structures. Their work in Ni-base alloys emphasizes new information concerning the decomposition dynamics obtained from wide-angle x-ray diffraction and small-angle neutron scattering techniques. Determination of interdiffusion coefficients, interfacial energy, as well as the testing of dynamical scaling laws are of primary interest.

33831 (DOE/ER/01198–T14, pp. 307-315) **Atomic-scale mechanisms of vapor-phase crystal growth.** Rockett, A. Illinois Univ., Urbana, IL (USA). Materials Research Lab. Mar 1988. In *Materials Research Laboratory: Renewal proposal for the extension in time and funds.* Order Number DE88013776/JAW. Available from NTIS, PC A99/MF A01; 1.

This is a new project, established during FY 88. The goals are to understand the atomic-scale processes which determine the surface structure and morphology of single crystals growing epitaxially from the vapor phase and to control them. The program will explore and attempt to improve some of the common assumptions about crystal growth and surface adatom motion. The project goals will be accomplished using both experimental and theoretical methods. Theoretical calculations will be based on numerical simulations of crystal growth using the Monte Carlo technique. Unlike previous simulations, the model to be used includes the structure and reconstruction of the film surface explicitly and permits simulation of surfaces tilted with respect to the (001) plane. The theoretical

portion of the program will strongly emphasize calculation of experimental observables, when possible, to assist in interpretation of observed phenomena. The calculations will be verified by concurrent experimental observation of surfaces during growth by molecular beam epitaxy (MBE). The experimental portion of the program will examine fundamental aspects of vapor-phase film growth, including the modification of surfaces by low-energy ion beams. For this purpose, compact, broad-beam, ion sources, compatible with the MBE facility now being installed at the Coordinated Science Laboratory, will be developed. The project will also include construction of a reflection high-energy electron diffraction data acquisition system. This system will provide information on the growing film surface which will be simulated using the model calculation.

33832 (DOE/ER/01198–T14, pp. 317-329) **Microwave studies of tunneling states in disordered materials.** Stapleton, H.J. Illinois Univ., Urbana, IL (USA). Materials Research Lab. Mar 1988. In *Materials Research Laboratory: Renewal proposal for the extension in time and funds.* Order Number DE88013776/JAW. Available from NTIS, PC A99/MF A01; 1.

The purpose of their measurements is to gather data on the low temperature, microwave frequency response from a variety of amorphous or glassy materials that exhibit characteristic properties associated with localized excitations, such as two level tunneling states or fractions (quantized vibrational modes on fractal structures). The techniques employed include: electron paramagnetic resonance, electron spin-lattice relaxation and microwave frequency dielectric absorption or dispersion. Measurements are performed in the temperature range between 0.3-20K, using He-3 and He-4 as refrigerants. Materials involved in their current or most recent research include: rare earth doped glasses [lead phosphate (PbO/P_2O_5), silicates, borates and fluorides], rare earth doped lanthanum orthosphosphate powders; small (under 500Åon edge) MgO:Mn powders; amorphous silicon produced by ion implantation of silicon, argon, neon, oxygen, or nitrogen into crystalline slabs of silicon; and sodium, potassium, or lithium beta alumina. The spin relaxation recovery profiles observed in lead phosphate glasses and MgO:Mn powders exhibit a stretched exponential form. In amorphous silicon, relaxation by tunneling states qualitatively explains the data. Initial measurements on microwave frequency dielectric losses in sodium beta alumina exhibit effects associated with the presence of localized two level tunneling states.

33833 (DOE/ER/01198–T14, pp. 351-361) **Ultrasonic studies of radiation effects.** Granato, A.V. Illinois Univ., Urbana, IL (USA). Materials Research Lab. Mar 1988. In *Materials Research Laboratory: Renewal proposal for the extension in time and funds.* Order Number DE88013776/JAW. Available from NTIS, PC A99/MF A01; 1.

The purpose of this project is to obtain basic information concerning the configuration and dynamics of isolated point defects, and of their interactions with each other in semiconductors and metals. The principal technique used is that of measurement of ultrasonic attenuation and velocity changes after irradiation with 2.5 MeV electrons. High sensitivity and the polarization dependence are the principal features of the technique which are exploited to obtain information about the configurations and dynamics of isolated defects at the ppm level, where most other direct spectroscopic techniques cannot be used. The responses are of paraelastic (relaxation) and diaelastic (resonance) type, with measurements as a function of polarization, temperature, defect concentration, frequency and annealing providing information on symmetries, diffusion parameters, and dipole strengths of the defects. The technique is relatively new in point defect studies, and both experimental and theoretical aspects are under development. Systems presently under study are irradiation induced defects in silicon and gallium arsenide, interstitials in iron and molybdenum, and interstitial-impurity complexes in niobium and aluminum. Impurity-interstitial complexes play an important role in radiation damage reactions in metals and semiconductors, while diaelastic measurements are useful in determining the structure and dynamics of interstitials in bcc metals.

33834 (DOE/ER/01198–T14, pp. 363-392) **Radiation effects in metals and semiconductors.** Robertson, I.M. Illinois Univ., Urbana, IL (USA). Materials Research Lab. Mar 1988. In *Materials Research Laboratory: Renewal proposal for the extension in time and funds.* Order Number DE88013776/JAW. Available from NTIS, PC A99/MF A01; 1.

The in-situ TEM irradiation technique is being used to investigate the change produced in the microstructure by heavy-ion irradiations in both metal and semiconductor systems. The in-situ irradiations and electron microscopy are performed at Argonne National Laboratory where an ion accelerator has been interfaced with the High-voltage electron microscope. The sample temperature can be varied from 10 to 100 K which allows the irradiations and microscopy to be performed at temperatures where the defects are immobile. In addition, the same sample area and the fate of individual defects can be directly observed as the irradiation conditions are altered. The aim of this program is to provide insight into: (a) the parameters that influence the collapse of a displacement cascade to a vacancy loop and why this probability is dependent on the metal and the alloy content, and (b) the crystalline-amorphous transition produced in semiconductors by heavy-ion irradiation and the thermal stability of these amorphous zones. The models that stem from the Molecular Dynamic Computer Simulation Studies will be used to aid the interpretation of the electron microscopy results.

33835 (DOE/ER/01198–T14, pp. 393-401) **Low temperature studies of defects in solids.** Anderson, A.C. Illinois Univ., Urbana, IL (USA). Materials Research Lab. Mar 1988. In *Materials Research Laboratory: Renewal proposal for the extension in time and funds.* Order Number DE88013776/JAW. Available from NTIS, PC A99/MF A01; 1.

The purpose of this project is to obtain experimental data on a variety of defect structures, both to provide a basic understanding of the defects and to permit prediction of the behavior of bulk properties when defects and disorder are present. Reduced temperatures (0.02-300K) are used in the investigation since (a) such data are often more amenable to theoretical interpretation and thus provide a foundation for a general theoretical development, and (b) because some important phenomena, such as superconductivity, occur only at low temperatures. Several measurement techniques are used: thermal and electrical conductivity, specific heat, thermal expansion, ultrasonic and dielectric dispersion. Current research includes: the study of charge density wave phenomena; thermal transport phenomena in superconducting metals; quantum-mechanical tunneling states in alkali halides and in disordered solids; the interaction between phonons and dislocations in dielectric materials; the scattering of thermal phonon at crystalline interfaces; and the general problem of heat transport and thermal response in metals, polymers, ceramics and composite materials appropriate to cryogenic engineering.

33836 (DOE/ER/01198–T14, pp. 403-421) **Electronic properties of semiconductor surfaces and interfaces.** Chiang, T.C. Illinois Univ., Urbana, IL (USA). Materials Research Lab. Mar 1988. In *Materials Research Laboratory: Renewal proposal for the extension in time and funds.* Order Number DE88013776/JAW. Available from NTIS, PC A99/MF A01; 1.

This research aims to study the growth behaviors, the resulting atomic structure, and the electronic properties of surfaces, interfaces, overlayers, and multilayer heterostructures. Materials that are of scientific and technological interest will be chosen for the authors study. Specifically, their study will focus on atomically ordered surfaces of group-IV, III-V, and II-VI semiconductor systems as well as semiconductor and metal epitaxial overlayers grown on these substrates. The goal is to obtain a fundamental understanding of the behaviors and properties of these systems; the knowledge gained from this study is relevant to the development of new materials concepts. In their experiments, samples will be prepared in situ by molecular beam epitaxy (MBE) and standard surface science techniques. The growth conditions will be optimized to obtain the desired atomic configurations and to search for new atomic structures. The samples will be characterized in terms of atomic order, growth mode, crystal structure, morphology, and composition by low-energy and high-energy electron diffraction, Auger spectroscopy, etc. The authors will determine the effects of lattice mismatch between the overlayer and the substrate and the resulting strain, which may lead to interesting modifications of the material properties. The electronic properties, including the bulk and surface band structures, interface states, core level shifts, multielectron excitations, Schottky barrier

heights, heterojunction potentials, etc., will be probed by synchrotron photoemission. In addition, they will use a scanning tunneling microscope for in situ examination of MBE grown surfaces to determine the atomic locations and electronic properties during the initial stages of crystal growth and interface formation.

33837 (DOE/ER/01198–T14, pp. 423-432) **Theory of solids, surfaces, and heterostructures.** Martin, R.M. Illinois Univ., Urbana, IL (USA). Materials Research Lab. Mar 1988. In *Materials Research Laboratory: Renewal proposal for the extension in time and funds.* Order Number DE88013776/JAW. Available from NTIS, PC A99/MF A01; 1.

The research program described in this proposal is a broad theoretical study of the properties of materials. The theoretical methods used in their studies are chosen so that they can carry out ab initio calculations on many different materials properties in a unified way. Thus their work includes detailed computations on well-known crystals to test the methods and application of the same techniques to predict properties of novel, unknown materials, such as surfaces and man-made heterostructures. The authors also focus upon problems in which many-body correlations of the electrons lead to qualitative effects, e.g., the new ceramic superconductors and related materials. Initial work includes density functional studies to explore ways that introducing atomic layers can control the electrical properties of semiconductor interfaces, stability of surfaces of compound semiconductors, and Quantum Monte Carlo calculations of simple models related to high Tc superconductors. Examples of long range goals include studies of catalysis and growth of crystals from liquid and vapor phases, including both thermal atomic motions and quantum electronic effects.

33838 (DOE/ER/01198–T14, pp. 433-446) **Growth and properties of novel structures grown by M.B.E.** Morkoc, H.; Flynn, C.P. Illinois Univ., Urbana, IL (USA). Materials Research Lab. Mar 1988. In *Materials Research Laboratory: Renewal proposal for the extension in time and funds.* Order Number DE88013776/JAW. Available from NTIS, PC A99/MF A01; 1.

This project began with two complementary purposes. The first was to establish and develop a major central facility, The EpiCenter for the epitaxial growth and in situ characterization of state-of-the-art crystalline materials structures and surfaces. The second purpose was to fund part of the EpiCenter operations concerned with the growth of energy-related materials systems that are of direct interest to DOE research programs. The 40' x 80' clean environment of the EpiCenter is now almost finished, and installation of the equipment is expected to be completed by 4/30/88. Seven machines for molecular beam epitaxial growth of semiconductors, metals and ceramics provide the crystal growth capability of the EpiCenter. They are so interconnected that material grown in one environment can be transferred to a second growth environment without surface contamination, thereby offering unique flexibility in epitaxial processing. Five of the machines covering all materials types, are operated through this project. Three categories of DOE funded research are to be pursued: (a) growth of semiconductor, metal and ceramic surface systems for controlled studies of surface structure kinetics and reactions; (b) growth of novel heterostructure assemblies for collaborative research into the properties of interfaces, quantum wells and superlattices; and (c) in situ investigations of heteroepitaxial growth and metastable structure using the unique capabilities of the EpiCenter for selection of incompatible growth environments without the degrading effects of surface contamination.

33839 (DOE/ER/01198–T14, pp. 465-480) **Nuclear magnetic resonance in solids.** Slichter, C.P. Illinois Univ., Urbana, IL (USA). Materials Research Lab. Mar 1988. In *Materials Research Laboratory: Renewal proposal for the extension in time and funds.* Order Number DE88013776/JAW. Available from NTIS, PC A99/MF A01; 1.

The interests of this group are in fundamental studies of solids and surfaces, principally by magnetic resonance. Included are many-body problems, superconductivity, phase transitions, magnetism, solids which possess unusual properties (such as charge density waves), and electronic, structural, and dynamic aspects of surface atoms and adsorbed molecules. For example, the authors have studied the spatial form of the charge density wave in the one-dimensional conductor $NbSe_3$ and its motion under applied electric fields. In conjunction with Dr. John Sinfelt of the Exxon Research Laboratories, they are studying surface phenomena of an important class of catalysts, small particles of Pt or other group VIII transition metals (in which 5% to 75% the metal atoms are on the surface of the particles) supported on alumina. The authors employ the ^{195}Pt NMR to study how the electronic structure of the surface Pt atoms depends on what atoms (if any) are adsorbed on the surface. By ^{13}C, ^{1}H, $^{2}H_2$ or ^{17}O NMR, they investigate the bonding and structure of adsorbed molecules such as CO, C_2H_2 or C_2H_4. They make extensive use of special methods such as observing the resonance of one species of nucleus while exciting a second resonance, to enable them to see resonances otherwise too weak to observe, or to show which nuclei are bonded to each other, measure bond lengths, and determine the structure of molecules. Some of the first work confirmed the pairing concept of the Bardeen-Cooper-Schrieffer (BCS) theory of superconductivity. Currently, they are studying high temperature superconductors by ^{63}Cu and ^{65}Cu NMR.

33840 (DOE/ER/01198–T14, pp. 481-492) **Carrier transport in quantum wells-picosecond imaging.** Wolfe, J.P. Illinois Univ., Urbana, IL (USA). Materials Research Lab. Mar 1988. In *Materials Research Laboratory: Renewal proposal for the extension in time and funds.* Order Number DE88013776/JAW. Available from NTIS, PC A99/MF A01; 1.

Picosecond imaging techniques will be developed to measure the lateral transport of photoexcited carriers in semiconductor quantum wells. Optical pulse-probe methods using picosecond laser sources will be combined with spatial imaging methods. The principal goal is to characterize the ambipolar motion of carriers in the plane of the quantum well. Multiple quantum wells of GaAs/AlGaAs with a range of layer thicknesses will be examined. Non-equilibrium electron-hole pairs are produced by a tightly focused laser pulse of 1ps duration and variation wavelength. A second dye-laser pulse tuned to the exciton resonance samples the optical absorption of the excited region, giving the non-equilibrium carrier distribution as a function of space and time. High resolution luminescence imaging techniques will also be employed to measure the energy distribution of photoexcited carriers. Measurements of the energy and spatial distributions of excitons and electron hole plasmas under a variety of conditions will reveal the basic scattering process of carriers with interfaces, phonons and impurities in the semiconductor quantum wells.

33841 (DOE/ER/01198–T14, pp. 493-508) **Structure and dynamics of surfaces, interfaces and heterostructures.** Zabel, H. Illinois Univ., Urbana, IL (USA). Materials Research Lab. Mar 1988. In *Materials Research Laboratory: Renewal proposal for the extension in time and funds.* Order Number DE88013776/JAW. Available from NTIS, PC A99/MF A01; 1.

The proposed research focuses on the structure and dynamics of epitaxial films, interfaces, and superlattices. The author is presently studying the structure of thin GaAs films epitaxially grown on Si(100) substrates, the surface order-disorder transition of Cu_3Au, and the strain modulation and critical fluctuations of hydrogen in metallic superlattices. These experiments are carried out using, in part, surface sensitive x-ray scattering methods under grazing incident wave conditions. A new x-ray spectrometer is now being developed for in-situ studies of epitaxial films and interfaces within the EpiCenter of the Materials Research Laboratory. He is also presently developing thermal neutron scattering as a surface sensitive probe, which will open up a new area of surface physics on surface structures and surface magnetism. In another work he is investigating the structure and thermal properties of single crystals of $YBa_2CuO_{7-\delta}$.

33842 (DOE/ER/01198–T14, pp. 509-523) **Pressure tuning spectroscopy.** Drickamer, H.G. Illinois Univ., Urbana, IL (USA). Materials Research Lab. Mar 1988. In *Materials Research Laboratory: Renewal proposal for the extension in time and funds.* Order Number DE88013776/JAW. Available from NTIS, PC A99/MF A01; 1.

The central theme of this research is the use of very high pressure to understand the electronic properties of materials. Ultimately, new or improved materials can be designed from the basis of this understanding. The basic effect of pressure is to decrease interatomic distance and thus to perturb electronic orbitals. These perturbations can be used to pressure tune energy levels thus to test theories to bring about electronic transitions or to relate changes in electronic properties to changes in bulk properties. Over

the past three decades the authors have utilized such various tools as optical absorption and fluorescence, electrical resistivity, x-ray diffraction and Moessbauer resonance to extract information about electronic interactions in solids. Recently they have added the capacity to make high pressure measurements of bond characteristics using a FTIR spectrometer. The current work involves the study by optical absorption, of excitations on metal cluster and metallorganic compounds, and of electron transfer, spin flip and thermochromic processes. These localized excitations are used as probes of local interactions in polymers, glasses, zeolite cages and intercalates. The long range goal is to contribute to the understanding of electronic processes in solids and to provide information of use in catalyst design, solid state chemistry, and energy recovery.

33843 (DOE/ER/01198–T14, pp. 547-555) **Optical spectroscopy of surface processes in thin film deposition.** Seebauer, E.G. Illinois Univ., Urbana, IL (USA). Materials Research Lab. Mar 1988. In *Materials Research Laboratory: Renewal proposal for the extension in time and funds.* Order Number DE88013776/JAW. Available from NTIS, PC A99/MF A01; 1.

Investigations of the surface chemistry involved in the deposition of thin GaAs films are underway. These studies combine traditional surface science methods such as temperature-programmed desorption and low-energy electron diffraction with much newer optical techniques such as photoreflectance (PR) and surface second harmonic generation (SHG). These photon-based techniques are capable of probing adsorption/desorption behavior from pressures in the ultrahigh vacuum range to atmospheric, thus bridging the gap between these regimes. Furthermore, very high spatial resolution ($\sim 0.5\mu$) is attainable, thus permitting studies of surface diffusion. PR examines primarily the linear part of the surface dielectric response, while SHG is sensitive to the quadratic part. These surface properties are expected to respond differently to adsorption, so that PR and SHG should be viewed as complementary.

33844 (DOE/ER/01198–T14, pp. 557-567) **Surface studies of boundary layer films.** Gellman, A.J. Illinois Univ., Urbana, IL (USA). Materials Research Lab. Mar 1988. In *Materials Research Laboratory: Renewal proposal for the extension in time and funds.* Order Number DE88013776/JAW. Available from NTIS, PC A99/MF A01; 1.

The long range goal of this project is to understand the factors that determine the mechanical properties of interfaces between solid surfaces. Such knowledge is essential for an understanding of adhesive and frictional forces at interfaces. Their purpose is to measure these properties under controlled conditions in which surface structure and composition can be characterized and, at the same time, varied as desired. Single crystal metal surfaces of known crystallographic orientation will be studied initially, with interfaces formed either between pairs of perfectly clean surfaces or between surfaces covered with boundary layer films of adsorbed species. The intention is to determine the factors important in bonding or adhesion across clean interfaces, and the characteristics of adsorbed molecules that modify frictional properties. The adsorbates chosen for initial study are straight chain carboxylic acids, which are often present as additions in lubricant mixtures. These form surfactant-like layers on metal surfaces similar in nature to Langmuir-Blodgett films. Their approach combines methods of surface science with measurements of interfacial forces. Clean and/or adsorbate covered surfaces will be prepared under ultra-high vacuum conditions and characterized by electron diffraction, Auger spectroscopy and photoemission methods. In situ measurements of these interfacial properties under highly controlled conditions will lead to an understanding of the role of surface structure, surface composition and boundary layer films in tribology.

33845 (DOE/ER/01198–T14, pp. 569-576) **Magnetic properties of surfaces and interfaces.** Salamon, M.B. Illinois Univ., Urbana, IL (USA). Materials Research Lab. Mar 1988. In *Materials Research Laboratory: Renewal proposal for the extension in time and funds.* Order Number DE88013776/JAW. Available from NTIS, PC A99/MF A01; 1.

This new project will focus on the unique magnetic properties of surfaces, overlayers, and interfaces. In situ characterization methods will be developed for incorporation in the epitaxial growth facility (EpiCenter) being developed within the Materials Research Laboratory. This will open for exploration a wide range of topics in surface magnetism, including rare-earth/transition metal interfaces and magnetic overlayers on metals and semiconductors under very clean conditions. The primary tool to be developed is conversion electron Moessbauer spectroscopy, to include ^{161}Dy and ^{166}Er as well as conventional ^{57}Fe spectroscopy. This technique is capable of detecting more complex order, such as antiferromagnetism and spin glass behavior, unlike methods that measure only the average magnetization. An effort to develop spin-dependent scanning tunneling microscopy will also be undertaken, initially in collaboration with IBM. Ex situ measurements such as magnetometer studies, magneto-optical Kerr effect, and surface neutron diffraction (collaboration with Zabel) will complement the proposed in situ work.

33846 (DOE/ER/45080–T3) **Local density theory of heats of formation and short-range order parameters in substitutionally disordered alloys: Final technical report.** Freeman, A.J.; Gonis, A. Northwestern Univ., Evanston, IL (USA). Dept. of Physics and Astronomy. 1988. 15p. Sponsored by DOE Energy Research. DOE Contract FG02-84ER45080. Order Number DE89014696/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Since previous Progress Reports presented results obtained in several other areas of our research, we highlight some results here of our investigations of the energetics of alloy phase diagrams. These have been carried out along both a theoretical and computational front. The theoretical studies were necessitated by the need to apply Green function methods, or the Korringa-Kohn-Rostoker (KKR) formalism, to a diverse number of cases such as isolated impurities, substitutional or interstitial, in pure elemental solids and in substitutionally disordered alloys, and to the treatment of lattice relaxation around impurities. Our computational endeavors were directed toward developing computer programs based on theoretical advances and toward refining existing codes. In the following we describe briefly the results we have obtained thus far along theoretical and computational lines. 4 figs.

33847 (DOE/ER/45213–6) **Microchemical analysis of intermetallic alloys using the field-ion microscope atom probe: Progress report, [July 1, 1988–December 31, 1988].** Brenner, S.S. Pittsburgh Univ., PA (USA). Dept. of Materials Science and Engineering. 1 Feb 1989. 8p. Sponsored by DOE Energy Research. DOE Contract FG02-85ER45213. (CONF-8811161–5: MRS symposium on high-temperature ordered intermetallic alloys, Boston, Massachusetts, USA, 28 Nov - 3 dec 1988). Order Number DE89013112/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

During the period July 1, 1988 to December 31, 1988 considerable progress has been made in characterizing the distribution of solute atoms in nickel aluminide. Topics covered by this report are: controlled backpolishing of FIM needles; analysis of grain boundaries in B-doped Al-rich Ni_3Al; clustering of boron in B-doped, Al-rich Ni_3Al; segregation of carbon to grain boundaries in Ni_3 Al; site occupation probability of tantalum in Ni_3Al; and atom probe analysis of Co_3Ti. (JL)

33848 (EMR/MTL–88-29) **Effect of high heat input on the microstructure and mechanical properties of submerged-arc welds in steels for arctic and offshore structures.** Gianetto, J.A.; Bowker, J.T.; Orr, R.F.; Letts, M.W. Canada Centre of Mineral and Energy Technology, Ottawa, ON (Canada). Metals Technology Labs. 1988. 52p. (MICROLOG–89-00490). Available from Canada Centre for Mineral and Energy Technology, Technical Information Division, 555 Booth St., Rm. 342, Ottawa, ON, Canada K1A 0G1; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The microstructure/mechanical property relationships of the weld metal and heat-affected zone (HAZ) regions were evaluated for a series of submerged-arc welds deposited at 3 and 6 kJ/mm heat inputs in a range of C-Mn microalloyed steels. In addition, Gleeble simulation was employed to evaluate the HAZ notch toughness of the microalloyed steels. The results showed that the HAZ notch toughness requirement (35 J at -40^{0}C) could only be met using the Ti microalloyed, low carbon (350WT strand cast) steel. In general, this was attributed to the presence of stable (TiNb)-(CN) precipitates which acted to restrict grain growth and produce a prior austenite

grain size of approximately 55 μ. The remaining steels displayed poor toughness after simulation due to excessive grain growth resulting in a prior austenite grain size of the order of 120 um. The HAZ notch toughness of the real welds (measured 1 mm from the fusion line) exceeded the targeted level at the 3 kJ/mm heat input for all steels; however, only the 350WT strand cast steel exhibited adequate toughness at 6 kJ/mm. The loss of toughness at 6 kJ/mm was related to the increased proportion of HAZ being tested (size of local brittle zone) and to the overall coarsening of the microstructure. The required weld metal notch toughness (35 J at -40^{0}C) was only achieved for welds deposited at 3 kJ/mm using a multipass welding technique. This resulted in a microstructure consisting of a relatively high proportion of acicular ferrite in the as-deposited regions, combined with approximately 20% reheated weld metal. In the 6 kJ/mm welds, the microstructure was coarser and a higher proportion of grain boundary ferrite contributed to the decrease in notch toughness. 43 refs., 26 figs., 10 tabs.

33849 (INIS-BR–1483, pp. 4) **Heat treatment influence on the crystalline quality of Bridgman grown Hg_{1-x} Cd_x Te.** Nollmann, I. (Programa de Investigaciones en Solidos, Buenos Aires (Argentina)); Trigubo, A.B.; Reca, N.E.W. de. Minas Gerais Univ., Belo Horizonte (Brazil). Dept. de Fisica. 1989. (CONF-8901126–: 4. Brazilian school of semiconductor physics, Belo Horizonte, Brazil, 23 Jan - 3 feb 1989). In *Proceedings of the 4. Brazilian School of Semiconductor Physics.* Order Number DE89612194/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Published in summary form only.

33850 (INIS-BR–1483, pp. 5) **MOCVD growth and characterization of GaInAs thick layers on InP substrates.** Machado, A. (TELEBRAS, Campinas, SP (Brazil). Centro de Pesquisas); Sacilotti, M.A.; Horiuchi, L.; Campos, H.; Loural, M.S.S.; Lamas, A.; Cardoso, L.P. Minas Gerais Univ., Belo Horizonte (Brazil). Dept. de Fisica. 1989. (In Portuguese). (CONF-8901126–: 4. Brazilian school of semiconductor physics, Belo Horizonte, Brazil, 23 Jan - 3 feb 1989). In *Proceedings of the 4. Brazilian School of Semiconductor Physics.* Order Number DE89612194/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

ARSENIC/gallium; ARSENIC/indium; GALLIUM/arsenic; GALLIUM/indium; GALLIUM/ternary alloy systems; INDIUM/arsenic; INDIUM/gallium; INDIUM/phosphorus; INDIUM/substrates; INDIUM/ternary alloy systems; PHOSPHORUS/indium; PHOSPHORUS/substrates; PHOSPHORUS/ternary alloy systems; TERNARY ALLOY SYSTEMS/crystal growth; TERNARY ALLOY SYSTEMS/crystal structure; TERNARY ALLOY SYSTEMS/x-ray diffraction; ARSENIC; GALLIUM; INDIUM; CHEMICAL COMPOSITION; CHEMICAL VAPOR DEPOSITION; ELECTRO-OPTICAL EFFECTS; PHOSPHORUS; SUBSTRATES; LAYERS; SEMICONDUCTOR MATERIALS

33851 (INIS-BR–1483, pp. 7) **Growth and structural properties of sputtered CdXTe thin film alloys.** Jimenez, S.S. (Instituto Politecnico Nacional, Mexico City (Mexico). Centro de Investigacion y de Estudios Avanzados); Hernandez, C.I. Minas Gerais Univ., Belo Horizonte (Brazil). Dept. de Fisica. 1989. (CONF-8901126–: 4. Brazilian school of semiconductor physics, Belo Horizonte, Brazil, 23 Jan - 3 feb 1989). In *Proceedings of the 4. Brazilian School of Semiconductor Physics.* Order Number DE89612194/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

CADMIUM TELLURIDES/ternary alloy systems; CADMIUM TELLURIDES/thin films; TERNARY ALLOY SYSTEMS/crystal growth; THIN FILMS/sputtering; ANNEALING; CRYSTAL-PHASE TRANSFORMATIONS; GRAIN SIZE; MANGANESE COMPOUNDS; MOLYBDENUM COMPOUNDS; TEMPERATURE DEPENDENCE; SPUTTERING; X-RAY DIFFRACTION; ZINC COMPOUNDS

33852 (INIS-BR–1483, pp. 10) **Growth and characterization of InGaAs P/Ga As with emission in 0.67 μ.** Sachs, A.C. (TELEBRAS, Campinas, SP (Brazil). Centro de Pesquisas); Gazetta Filho, H.; Loural, M.S.S.; Lamas, A.; Morelhao, S.L.; Cardoso, L.P. Minas Gerais Univ., Belo Horizonte (Brazil). Dept. de Fisica. 1989. (In Portuguese). (CONF-8901126–: 4. Brazilian school of semiconductor physics, Belo Horizonte, Brazil, 23 Jan - 3 feb 1989). In *Proceedings of the 4. Brazilian School of Semiconductor Physics.* Order Number DE89612194/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

ARSENIC/quaternary alloy systems; GALLIUM/quaternary alloy systems; GALLIUM ARSENIDES/substrates; INDIUM/quaternary alloy systems; PHOSPHORUS/quaternary alloy systems; QUATERNARY ALLOY SYSTEMS/crystal growth; QUATERNARY ALLOY SYSTEMS/lattice parameters; ARSENIC; GALLIUM; SUBSTRATES; INDIUM; NEUTRON DIFFRACTION; PHOSPHORUS; PHOTOLUMINESCENCE; X-RAY DIFFRACTION

33853 (INIS-BR–1483, pp. 29) **Photoluminesce spectra and carrier mobility in CdTe polycrystal films.** Figueroa, J.M. (Instituto Politecnico Nacional, Mexico City (Mexico). Centro de Investigacion y de Estudios Avanzados); Sanchez S, F.; Mendoza A, J.G.; Zelaya, O. Minas Gerais Univ., Belo Horizonte (Brazil). Dept. de Fisica. 1989. (In Spanish). (CONF-8901126–: 4. Brazilian school of semiconductor physics, Belo Horizonte, Brazil, 23 Jan - 3 feb 1989). In *Proceedings of the 4. Brazilian School of Semiconductor Physics.* Order Number DE89612194/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

CADMIUM TELLURIDES/carrier mobility; CADMIUM TELLURIDES/photoluminescence; CADMIUM; PHOTOLUMINESCENCE; CRYSTAL GROWTH; FILMS; GRAIN SIZE; POLYCRYSTALS; VACANCIES

33854 (INIS-BR–1483, pp. 48) **Spin-splitted phase transition in quantized hall effect of narrow-gap Hg(Cd) Te mosfet.** Silva, M.S. (Sao Paulo Univ., Sao Carlos, SP (Brazil). Inst. de Fisica e Quimica); Marques, G.E. Minas Gerais Univ., Belo Horizonte (Brazil). Dept. de Fisica. 1989. (CONF-8901126–: 4. Brazilian school of semiconductor physics, Belo Horizonte, Brazil, 23 Jan - 3 feb 1989). In *Proceedings of the 4. Brazilian School of Semiconductor Physics.* Order Number DE89612194/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

CADMIUM/mercury; CADMIUM/mosfet; CADMIUM/tellurium; MERCURY/cadmium; MERCURY/mosfet; MERCURY/tellurium; MOSFET/hall effect; MOSFET/phase transformations; TELLURIUM/cadmium; TELLURIUM/mercury; TELLURIUM/mosfet; CADMIUM; MERCURY; MOSFET; TELLURIUM; ELECTRON-ELECTRON INTERACTIONS; IMPURITIES; MAGNETIC FIELDS; MAGNETIC SUSCEPTIBILITY; RANDOM PHASE APPROXIMATION; SPIN

33855 (INIS-BR–1483, pp. 78) **Study of the profile of Zn diffusion in InGaAs ternary layers by C-V electrochemical technique.** Loural, M.S.S. (TELEBRAS, Campinas, SP (Brazil). Centro de Pesquisas); Sato, E.A.S.; Lima, R.S. Minas Gerais Univ., Belo Horizonte (Brazil). Dept. de Fisica. 1989. (In Portuguese). (CONF-8901126–: 4. Brazilian school of semiconductor physics, Belo Horizonte, Brazil, 23 Jan - 3 feb 1989). In *Proceedings of the 4. Brazilian School of Semiconductor Physics.* Order Number DE89612194/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

GALLIUM ARSENIDES/indium compounds; GALLIUM ARSENIDES/photodetectors; GALLIUM ARSENIDES/uses; INDIUM COMPOUNDS/gallium arsenides; INDIUM COMPOUNDS/photodetectors; INDIUM COMPOUNDS/uses; DIFFUSION; PHOTODETECTORS; USES; LAYERS; ZINC

33856 (INIS-BR–1483, pp. 92) **Study of semiconductors by Moessbauer spectroscopy: a review.** Sanchez S, F. (Instituto Politecnico Nacional, Mexico City (Mexico). Centro de Investigacion y de Estudios Avanzados). Minas Gerais Univ., Belo Horizonte (Brazil). Dept. de Fisica. 1989. (CONF-8901126–: 4. Brazilian school of semiconductor physics, Belo Horizonte, Brazil, 23 Jan - 3 feb 1989). In *Proceedings of the 4. Brazilian School of Semiconductor Physics.* Order Number DE89612194/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

CADMIUM TELLURIDES/semiconductor materials; GALLIUM ARSENIDES/semiconductor materials; SEMICONDUCTOR MATERIALS/moessbauer effect; SILICON/semiconductor materials; SILICON

33857 (INIS-BR–1483, pp. 30) **Ultrafast relaxation of carriers in CdSe.** Miranda, R.S. (Universidade Estadual de Campinas, SP (Brazil). Inst. de Fisica); Portella, M.T.; Matinaga, F.M.; Decker, F.; Cruz, C.H.B.; Scarparo, M.A.F. Minas Gerais Univ., Belo Horizonte (Brazil). Dept. de Fisica. 1989. (CONF-8901126–: 4. Brazilian school of semiconductor physics, Belo Horizonte, Brazil, 23 Jan - 3

feb 1989). In *Proceedings of the 4. Brazilian School of Semiconductor Physics.* Order Number DE89612194/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

CADMIUM SELENIDES/carriers; CADMIUM SELENIDES/films; CADMIUM SELENIDES/relaxation time; CARRIERS; FILMS; ELECTRODEPOSITION; ELECTRON-PHONON COUPLING

33858 (INIS-BR–1483, pp. 32) **Geometry and stability of the (GaAs)n (In As)n and (GaP)n (In P)n ultrathin superlattices.** Figueiredo, S.K. de (Sao Paulo Univ., SP (Brazil). Inst. de Fisica); Ferraz, A.C. Minas Gerais Univ., Belo Horizonte (Brazil). Dept. de Fisica. 1989. (CONF-8901126–: 4. Brazilian school of semiconductor physics, Belo Horizonte, Brazil, 23 Jan - 3 feb 1989). In *Proceedings of the 4. Brazilian School of Semiconductor Physics.* Order Number DE89612194/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

GALLIUM ARSENIDES/indium arsenides; GALLIUM ARSENIDES/superlattices; GALLIUM PHOSPHIDES/indium phosphides; GALLIUM PHOSPHIDES/superlattices; INDIUM ARSENIDES/gallium arsenides; INDIUM ARSENIDES/superlattices; INDIUM PHOSPHIDES/gallium phosphides; INDIUM PHOSPHIDES/superlattices; SUPERLATTICES/electronic structure; SUPERLATTICES/geometry; SUPERLATTICES/stability; SUPERLATTICES; GEOMETRY; STABILITY

33859 (INIS-BR–1483, pp. 94) **Study of optical anisotropies in GA As (100) and Insb (100).** Ramos L, G.A. (Instituto Politecnico Nacional, Mexico City (Mexico). Centro de Investigacion y de Estudios Avanzados); Hernandez C, I. Minas Gerais Univ., Belo Horizonte (Brazil). Dept. de Fisica. 1989. (CONF-8901126–: 4. Brazilian school of semiconductor physics, Belo Horizonte, Brazil, 23 Jan - 3 feb 1989). In *Proceedings of the 4. Brazilian School of Semiconductor Physics.* Order Number DE89612194/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

ANTIMONY/semiconductor materials; GALLIUM ARSENIDES/semiconductor materials; INDIUM/semiconductor materials; SEMICONDUCTOR MATERIALS/anisotropy; SEMICONDUCTOR MATERIALS/optical properties; ANTIMONY; INDIUM; ANISOTROPY; SPECTROSCOPY; SURFACES

33860 (INIS-mf–11454, pp. 66-67) **Development of superconducting magnets using multifilament Nb_3Sn conductors.** Cesnak, L. (Slovenska Akademia Vied, Bratislava (Czechoslovakia). Elektrotechnicky Ustav); Goemoery, F. Ceskoslovenska Vedeckotechnicka Spolecnost, Usti nad Labem (Czechoslovakia). Dum Techniky. Apr 1988. (In Slovak). (CONF-8804279–: Cryogenics '88, Usti nad Labem, Czechoslovakia, 19-21 Apr 1988). In *Cryogenics '88.* Order Number DE89617941/JAW. Available from NTIS (US Sales Only), PC A10/MF A01 - OSTI; INIS.

Further development of stabilized Nb_3Sn multifilament conductors made it possible to build a three-section Nb-Ti + Nb_3Sn magnet. The system was successfully tested at various currents in the sections. The highest field reached was 8.8 T in the 40 mm bore of the inner section. In the last quench test with all sections in series the protection resistors - originally connected to the individual sections - were disconnected by mistake and the inner section was damaged by an arc between the two innermost layers. Test results with another three test coils are also reported. (author). 4 figs., 6 refs.

33861 (INIS-mf–11454, pp. 68-74) **Losses in superconducting wires in rotating magnetic field.** Sosnowski, J. (Instytut Elektrotechniki, Warsaw (Poland). Zaklad Badan Nieniszczacych). Ceskoslovenska Vedeckotechnicka Spolecnost, Usti nad Labem (Czechoslovakia). Dum Techniky. Apr 1988. (CONF-8804279–: Cryogenics '88, Usti nad Labem, Czechoslovakia, 19-21 Apr 1988). In *Cryogenics '88.* Order Number DE89617941/JAW. Available from NTIS (US Sales Only), PC A10/MF A01 - OSTI; INIS.

Dissipated power (losses) in superconducting wires, tapes placed in rotating magnetic field are studied. Electric fields and generated losses were investigated in all initial magnetic states where superconducting material can exist, i.e., in diamagnetic, paramagnetic and nonmagnetic states, for arbitrary magnetic induction profile. (author). 6 figs., 2 refs.

33862 (INIS-mf–11454, pp. 84-85) **Multifilament Nb_3Sn conductor consisting of Nb tubes.** Klabik, V. (Statni Vyzkumny Ustav Materialu, Prague (Czechoslovakia)); Plechacek, V.; Cesnak, L.; Goemoery, F. Ceskoslovenska Vedeckotechnicka Spolecnost, Usti nad Labem (Czechoslovakia). Dum Techniky. Apr 1988. (In Slovak). (CONF-8804279–: Cryogenics '88, Usti nad Labem, Czechoslovakia, 19-21 Apr 1988). In *Cryogenics '88.* Order Number DE89617941/JAW. Available from NTIS (US Sales Only), PC A10/MF A01 - OSTI; INIS.

The conductor consists of Nb tubes containing a Cu core and drawn in a bronze matrix. By appropriate heat treatment the growth of Nb_3Sn is limited to the tube wall and the conductance of the Cu core can be maintained. Thus the diffusion barrier can be saved and the conductors' current density enhanced. The first attempt is described to make such a conductor and build a magnet with it. (author). 3 figs., 1 tab., 1 ref.

33863 (INIS-mf–11982, pp. 2.1-2.14) **Failure behaviour of steels with different strength and toughness levels.** Dahl, W. (Technische Hochschule Aachen (Germany, F.R.). Lehrstuhl und Inst. fuer Eisenhuettenkunde); Hesse, W.; Hubo, R.; Twickler, R. Staatliche Materialpruefungsanstalt, Stuttgart (Germany, F.R.); Technische Hochschule Aachen (Germany, F.R.). Lehrstuhl und Inst. fuer Eisenhuettenkunde. 1987. (In German). (CONF-8710410–: 13. MPA seminar on safety and reliability of pressure components: the contribution of component and large specimen testing to structural integrity assessment methodology, Stuttgart, Germany, F.R., 8-9 Oct 1987). In *Safety and reliability of pressure components with special emphasis on the contribution of component and large specimen testing to structural integrity assessment methodology. Vol. 1. Fracture mechanics, dynamic loading, nondestructive testing, radiation embrittlement.* Order Number DE89783126/JAW. Available from NTIS (US Sales Only), PC A99/MF A01.

The increasing supply potential for high-strength and extremely high-strength construction steel is confronted by uncertainties regarding the quantification of the toughness requirements. With the aid of fracture mechanical assessment methods which allow both the material and component behaviour to be described with the same parameters, the method with which toughness requirements can be specified is demonstrated using centrally and surface-notched large-scale specimens. The required toughness gain achieved by high-strength steels - being decisively influenced by the geometry of the component in question - could be quantified for the given large-scale specimens.

33864 (INIS-mf–11982, pp. 27.1-27.20) **Consideration of irradiation embrittlement of RPV steels in licensing rules as compared to recent results of irradiation experiments.** Ahlf, J. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.)); Bellmann, D.; Schmitt, F.J.; Pott, G. Staatliche Materialpruefungsanstalt, Stuttgart (Germany, F.R.); GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.); Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). 1987. (In German). (CONF-8710410–: 13. MPA seminar on safety and reliability of pressure components: the contribution of component and large specimen testing to structural integrity assessment methodology, Stuttgart, Germany, F.R., 8-9 Oct 1987). In *Safety and reliability of pressure components with special emphasis on the contribution of component and large specimen testing to structural integrity assessment methodology. Vol. 1. Fracture mechanics, dynamic loading, nondestructive testing, radiation embrittlement.* Order Number DE89783126/JAW. Available from NTIS (US Sales Only), PC A99/MF A01.

The aim of the investigations into radiation embrittlement of reactor pressure vessel steels was to expand the empirical basis of the KTA regulations, and to qualify the safety margins. The investigations were focussed on the effect of radiation on the fracture toughness of large-scale CT and WOL specimens. The reason for this choice is that due to the extensive experimental labour involved, little information is presently available, but there is much interest worldwide in securing this fracture mechanical concept. The prerequisites for the consideration of the radiation embrittlement for the analysis of reactor pressure vessels are discussed on the basis of the results of the FKS radiation project, supplemented by the IAEO coordinated RPV-radiation program results. The following specimens have been investigated: KS01: a strake made of 22 NiMoCr 3 7; KS02: PWR closure head flange made of 22 NiMoCr 3

7; KS07B: lower-bound experimental melt; a slab with chemical composition not within the specification for 22 NiMoCr 3 7; KS16S: a strake made of 22 NiMoCr 3 7; KS12: a strake made of 20 MnMoNi 5 5; KS12ESU: remolten inner area of the KS12 strake; KS12SG: real weld metal for 20 MnMoNi 5 5; HSST03: plate made of ASTM A 533-B Cl.1.

33865 (INIS-mf–11982, pp. 30.1-30.19) **Crack resistance properties of through-cracks in austenitic straight pipes (DN 700) under bending.** Grueter, L. (Internationale Atomreaktorbau G.m.b.H. (INTERATOM), Bergisch Gladbach (Germany, F.R.)); Fortmann, M.; Bhandari, S.; Faidy, C. Staatliche Materialpruefungsanstalt, Stuttgart (Germany, F.R.); Internationale Atomreaktorbau G.m.b.H. (INTERATOM), Bergisch Gladbach (Germany, F.R.). 1987. (In German). (CONF-8710410–: 13. MPA seminar on safety and reliability of pressure components: the contribution of component and large specimen testing to structural integrity assessment methodology, Stuttgart, Germany, F.R., 8-9 Oct 1987). In *Safety and reliability of pressure components with special emphasis on the contribution of component and large specimen testing to structural integrity assessment methodology. Vol. 2. Pipe failure, components, thermal shock loading, high temperature behaviour, integrity of vessels, integrity of welded joints.* Order Number DE89783126/JAW. Available from NTIS (US Sales Only), PC A99/MF A01.

Bending tests are to be conducted on straight pipes (nominal diameter DN=700 mm, thickness t = 11 mm) of the austenitic steel 316 L with circumferential through-cracks of various sizes and at different locations. These are to be supplemented by fracture mechanical small-specimen tests and theoretical investigations. To date, four tests have been conducted, all at room temperature. The through-crack primed by previous fatigue, is loaded during the test by a displacement-controlled monotonically increasing bending moment. The crack propagation at various stages of the third test and the pipe geometry of all three may be extracted from illustrations. The investigations are focussed at determining the crack resistance curves.

33866 (INIS-mf–11982, pp. 40.1-40.20) **Multiaxial creep of tubes from Incoloy 800H and Inconel 617 under static and cyclic loading conditions.** Penkalla, H.J. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorwerkstoffe); Nickel, H.; Schubert, F. Staatliche Materialpruefungsanstalt, Stuttgart (Germany, F.R.); Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorwerkstoffe. 1987. (In German). (CONF-8710410–: 13. MPA seminar on safety and reliability of pressure components: the contribution of component and large specimen testing to structural integrity assessment methodology, Stuttgart, Germany, F.R., 8-9 Oct 1987). In *Safety and reliability of pressure components with special emphasis on the contribution of component and large specimen testing to structural integrity assessment methodology. Vol. 2. Pipe failure, components, thermal shock loading, high temperature behaviour, integrity of vessels, integrity of welded joints.* Order Number DE89783126/JAW. Available from NTIS (US Sales Only), PC A99/MF A01.

This paper is concerned with the description of creep under triaxial loading with the aid of Norton's law and v. Mises' theory. The load combination of internal pressure, tension and torsion is more closely scrutinized. The superposition of cyclic stresses in the tensile threshold range is discussed as well as the instances of partial relaxation. In accordance with the discussed loading modes, experimental results are presented which, until now, have delivered a satisfactory agreement between theory and practice. A more explicit analysis of the creep-induced damage is given regarding the assessment of the expected life until failure under triaxial loading. This delivers information concerning a suitable test stress for the long-term stress assessment.

33867 (INIS-mf–11982, pp. 41.1-41.22) **Fatigue and creep crack growth in methane reformer tubes at temperatures above 700^{0}C.** Roedig, M. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorwerkstoffe); Nickel, H.; Schubert, F.; Kienzler, R. Staatliche Materialpruefungsanstalt, Stuttgart (Germany, F.R.); Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorwerkstoffe; Fraunhofer-Institut fuer Werkstoffmechanik, Freiburg im Breisgau (Germany, F.R.). 1987. (In German). (CONF-8710410–: 13. MPA seminar on safety and reliability of pressure components: the contribution of component and large specimen testing to structural integrity assessment methodology, Stuttgart, Germany, F.R., 8-9 Oct 1987). In *Safety and reliability of pressure components with special emphasis on the contribution of component and large specimen testing to structural integrity assessment methodology. Vol. 2. Pipe failure, components, thermal shock loading, high temperature behaviour, integrity of vessels, integrity of welded joints.* Order Number DE89783126/JAW. Available from NTIS (US Sales Only), PC A99/MF A01.

The fatigue crack propagation of Incoloy 800H may be described by a linear-elastic algorithm up to temperatures of 850^{0}C. The crack growth in standard specimens and methane reformer tubes is specified by a parameter. The utilization of these tubes for over 8000 hours at temperatures of around 800^{0}C did not significantly influence the creep and fatigue crack propagation characteristics.

33868 (INIS-mf–11982, pp. 42.1-42.18) **Experimental and theoretical investigations of creep buckling on NiCr22Co12Mo tubes at 950^{0}C.** Schubert, F. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorwerkstoffe); Ahmed, K.; Breitbach, G.; Nickel, H. Staatliche Materialpruefungsanstalt, Stuttgart (Germany, F.R.); Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorwerkstoffe. 1987. (In German). (CONF-8710410–: 13. MPA seminar on safety and reliability of pressure components: the contribution of component and large specimen testing to structural integrity assessment methodology, Stuttgart, Germany, F.R., 8-9 Oct 1987). In *Safety and reliability of pressure components with special emphasis on the contribution of component and large specimen testing to structural integrity assessment methodology. Vol. 2. Pipe failure, components, thermal shock loading, high temperature behaviour, integrity of vessels, integrity of welded joints.* Order Number DE89783126/JAW. Available from NTIS (US Sales Only), PC A99/MF A01.

The problem of creep buckling was theoretically and experimentally investigated. The experiments were conducted using NiCr22Co12Mo (Inconel 617) tubes possessing different initial elliptical cross-sections. These were subjected to pressures of between 35 and 45 bar at temperatures of 950^{0}C, upon which the buckling periods were measured. Theoretical analyses were conducted under consideration of the relevant parameter scattering using a model conceived by Hoff and the finite-element-algorithm. Both methods are suitable, for the investigation of the creep-buckling phenomenon.

33869 (INIS-mf–11982, pp. 43.1-43.26) **Evaluation of the creep crack growth by means of a crack tip/far field concept.** Ewald, J. (Siemens A.G. Unternehmensbereich KWU, Muelheim an der Ruhr (Germany, F.R.)); Maile, K.; Tscheuschner, R. Staatliche Materialpruefungsanstalt, Stuttgart (Germany, F.R.); Kraftwerk Union A.G., Muelheim an der Ruhr (Germany, F.R.). 1987. (In German). (CONF-8710410–: 13. MPA seminar on safety and reliability of pressure components: the contribution of component and large specimen testing to structural integrity assessment methodology, Stuttgart, Germany, F.R., 8-9 Oct 1987). In *Safety and reliability of pressure components with special emphasis on the contribution of component and large specimen testing to structural integrity assessment methodology. Vol. 2. Pipe failure, components, thermal shock loading, high temperature behaviour, integrity of vessels, integrity of welded joints.* Order Number DE89783126/JAW. Available from NTIS (US Sales Only), PC A99/MF A01.

The crack initiation behaviour of ductile 1% CrMoV-steels can be assessed by the two-criterion creep-crack initiation diagram. This quantitatively takes into account the influencing parameters of the crack tip and the far field, whilst additionally defining the different damage categories, i.e. crack tip damage, ligament damage, and mixed-mode damage.

33870 (INIS-mf–11982, pp. 44.1-44.19) **MINERVA, qualification of dissimilar welds for HTR-application.** Baumann, B. (Asea Brown Boveri A.G., Mannheim (Germany, F.R.)); Gnirss, G.; Neureuther, H.; Schneider, K. Staatliche Materialpruefungsanstalt, Stuttgart (Germany, F.R.); Brown, Boveri und Cie A.G., Mannheim (Germany, F.R.). 1987. (In German). (CONF-8710410–: 13. MPA seminar on safety and reliability of pressure components: the contribution of component and large specimen testing to structural

integrity assessment methodology, Stuttgart, Germany, F.R., 8-9 Oct 1987). In *Safety and reliability of pressure components with special emphasis on the contribution of component and large specimen testing to structural integrity assessment methodology. Vol. 2. Pipe failure, components, thermal shock loading, high temperature behaviour, integrity of vessels, integrity of welded joints.* Order Number DE89783126/JAW. Available from NTIS (US Sales Only), PC A99/MF A01.

The 'MINERVA' test is part of a universal concept for the evaluation of the integrity of dissimilar welds in high-temperature reactor pipe joints. Using this, the local accumulative strains and damages, determined by inelastic analysis, can be verified. This report describes the concept and the fabrication parameters including the reasons for the process and material choice, together with the test equipment 'MINERVA'.

33871 (INIS-mf–11982, pp. 46.1-46.20) **J_R-curves of wide plates and CT25 specimens. Comparison of the results of a pressure vessel.** Aurich, D. (Bundesanstalt fuer Materialforschung und -pruefung, Berlin (Germany, F.R.)); Wobst, K.; Krafka, H. Staatliche Materialpruefungsanstalt, Stuttgart (Germany, F.R.); Bundesanstalt fuer Materialforschung und -pruefung, Berlin (Germany, F.R.). 1987. (In German). (CONF-8710410–: 13. MPA seminar on safety and reliability of pressure components: the contribution of component and large specimen testing to structural integrity assessment methodology, Stuttgart, Germany, F.R., 8-9 Oct 1987). In *Safety and reliability of pressure components with special emphasis on the contribution of component and large specimen testing to structural integrity assessment methodology. Vol. 2. Pipe failure, components, thermal shock loading, high temperature behaviour, integrity of vessels, integrity of welded joints.* Order Number DE89783126/JAW. Available from NTIS (US Sales Only), PC A99/MF A01.

In connection with the problem of the applicability of the characteristic specimen date - i.e. the initiation and stable crack propagation under maximal loads, together with the elastic-plastic material behaviour - to that of actual components, spot-check type beside tests were conducted using wide-plate central crack, central notch (CCT, CNT) and double external crack (DECT) samples. The material in question was an StE 460 steel. A comparison between the determined values shows that the assessed pressure vessel behaviour differs extensively to the values derived from the CCT and CNT specimens. The corresponding results obtained from the CT25 and DECT specimens vary only slightly in the region of interest and correspond to real vessel values.

33872 (INIS-mf–11982, pp. 48.1-48.14) **Inconel-X-750 as material for core internals and core components. Status of in-service experience and replacements.** Rubel, H. (Siemens A.G. Unternehmensbereich KWU, Erlangen (Germany, F.R.)); Tautz, J.; Micheel, G. Staatliche Materialpruefungsanstalt, Stuttgart (Germany, F.R.); Kraftwerk Union A.G., Erlangen (Germany, F.R.). 1987. (In German). (CONF-8710410–: 13. MPA seminar on safety and reliability of pressure components: the contribution of component and largc specimen testing to structural integrity assessment methodology, Stuttgart, Germany, F.R., 8-9 Oct 1987). In *Safety and reliability of pressure components with special emphasis on the contribution of component and large specimen testing to structural integrity assessment methodology. Vol. 2. Pipe failure, components, thermal shock loading, high temperature behaviour, integrity of vessels, integrity of welded joints.* Order Number DE89783126/JAW. Available from NTIS (US Sales Only), PC A99/MF A01.

Jointing and centralizing elements made of the high nickel base Inconel-X-750 alloy are used in water-cooled reactors all over the globe. The use of this alloy for specific components lead to defects which, in some cases, demanded replacement. A brief description of the areas of applications, the operationl experience, failure causes, material-specific remedies and repair concepts is given.

33873 (INIS-mf–11982, pp. 49.1-49.21) **Assessment of welded joints by the J-integral method.** Kraemer, D. (Stuttgart Univ. (Germany, F.R.). Staatliche Materialpruefungsanstalt); Eckert, W.; Roos, E.; Krolop, S. Staatliche Materialpruefungsanstalt, Stuttgart (Germany, F.R.). 1987. (In German). (CONF-8710410–: 13. MPA seminar on safety and reliability of pressure components: the contribution of component and large specimen testing to structural integrity assessment methodology, Stuttgart, Germany, F.R., 8-9 Oct 1987). In *Safety and reliability of pressure components with special emphasis on the contribution of component and large specimen testing to structural integrity assessment methodology. Vol. 2. Pipe failure, components, thermal shock loading, high temperature behaviour, integrity of vessels, integrity of welded joints.* Order Number DE89783126/JAW. Available from NTIS (US Sales Only), PC A99/MF A01.

In ductile fracture mechanics, the J-integral is an important parameter for the integrity assessment of components. The fact that and how an area- or path-independent J-integral can also be applied to inhomogeneous materials is demonstrated along with the actual method of applications. An especially important engineering aspect is, for example, welded joints, where it is also shown that for such inhomogeneous material characteristics, a path-independent J-integral or respective area-independent J tilde-integral exists, which is equal to the energy releasing rate. The results of finite-element calculations verify the theoretically derived conclusions.

33874 (INIS-mf–11982, pp. 5.1-5.24) **Prediction of large specimen fracture toughness from small specimen tests.** Iwadate, T. (Japan Steel Works Ltd., Muroran, Hokkaido. Muroran Plant); Suzuki, K.; Tanaka, Y. Staatliche Materialpruefungsanstalt, Stuttgart (Germany, F.R.); Japan Steel Works Ltd., Muroran, Hokkaido (Japan). Muroran Plant. 1987. (CONF-8710410–: 13. MPA seminar on safety and reliability of pressure components: the contribution of component and large specimen testing to structural integrity assessment methodology, Stuttgart, Germany, F.R., 8-9 Oct 1987). In *Safety and reliability of pressure components with special emphasis on the contribution of component and large specimen testing to structural integrity assessment methodology. Vol. 1. Fracture mechanics, dynamic loading, nondestructive testing, radiation embrittlement.* Order Number DE89783126/JAW. Available from NTIS (US Sales Only), PC A99/MF A01.

With the aid of microscopic observation, the source of fracture toughness scattering in the transition temperature-range was investigated using a Ni-Cr-Mo-V steel. Furthermore, the results of dynamic fracture toughness tests for twelve different steels were analysed in order to derive a correlation between the dynamic fracture toughness and other small-specimen test results such as the drop-weight, NDT temperature and the Charpy index temps.

33875 (INIS-mf–11982, pp. 51.1-51.24) **Contribution to the numerical and experimental determination of residual stresses in welds.** Kussmaul, K. (Stuttgart Univ. (Germany, F.R.). Staatliche Materialpruefungsanstalt); Roos, E.; Guth, W.; Szimmat, J. Staatliche Materialpruefungsanstalt, Stuttgart (Germany, F.R.); Stuttgart Univ. (Germany, F.R.). Inst. fuer Computeranwendungen. 1987. (In German). (CONF-8710410–: 13. MPA seminar on safety and reliability of pressure components: the contribution of component and large specimen testing to structural integrity assessment methodology, Stuttgart, Germany, F.R., 8-9 Oct 1987). In *Safety and reliability of pressure components with special emphasis on the contribution of component and large specimen testing to structural integrity assessment methodology. Vol. 2. Pipe failure, components, thermal shock loading, high temperature behaviour, integrity of vessels, integrity of welded joints.* Order Number DE89783126/JAW. Available from NTIS (US Sales Only), PC A99/MF A01.

Comprehensive investigations have determined the material behaviour under welding conditions, and as a dependent factor of the temperature, using samples of KS02. The results were a fundamental prerequisite for an efficient execution of the numerical calculations. It is demonstrated that the simulation of multiple layer welding may be conducted with the finite element method. A comparison with the experimental results has verified that for the temperature fields, good agreement exists. This also holds true for the stress calculations, despite the occurrence of local differences in the absolute values, especially in the vicinity of the weld center.

33876 (INIS-mf–11982, pp. 6.1-6.25) **Determination of J_R-curves by large scale specimen.** Roos, E. (Stuttgart Univ. (Germany, F.R.). Staatliche Materialpruefungsanstalt); Eisele, U.; Silcher, H.; Kiessling, D. Staatliche Materialpruefungsanstalt, Stuttgart (Germany, F.R.). 1987. (In German). (CONF-8710410–: 13. MPA seminar on safety and reliability of pressure components:

the contribution of component and large specimen testing to structural integrity assessment methodology, Stuttgart, Germany, F.R., 8-9 Oct 1987). In *Safety and reliability of pressure components with special emphasis on the contribution of component and large specimen testing to structural integrity assessment methodology. Vol. 1. Fracture mechanics, dynamic loading, nondestructive testing, radiation embrittlement.* Order Number DE89783126/JAW. Available from NTIS (US Sales Only), PC A99/MF A01.

The results demonstrate the possibility of determining J_R-curves from large-scale specimens of various geometries and different types of loading (tensile/bending). It is apparent that, in comparison to small specimens, the use of the partial relaxation method clearly demands an improved measuring technology in order to attain the required accuracy. The presented results demonstrate that although the J_R-curves are strongly dependent on the specimen geometry, this is not the case for the physical crack initiation factor J_i. Hence, this factor may be observed as a material parameter.

33877 (INIS-mf–11982, pp. 8.1-8.20) **Crack arrest toughness measurements at high temperatures by wedge-loaded compact-specimens.** Kussmaul, K. (Stuttgart Univ. (Germany, F.R.). Staatliche Materialpruefungsanstalt); Gillot, R. Staatliche Materialpruefungsanstalt, Stuttgart (Germany, F.R.). 1987. (In German). (CONF-8710410–: 13. MPA seminar on safety and reliability of pressure components: the contribution of component and large specimen testing to structural integrity assessment methodology, Stuttgart, Germany, F.R., 8-9 Oct 1987). In *Safety and reliability of pressure components with special emphasis on the contribution of component and large specimen testing to structural integrity assessment methodology. Vol. 1. Fracture mechanics, dynamic loading, nondestructive testing, radiation embrittlement.* Order Number DE89783126/JAW. Available from NTIS (US Sales Only), PC A99/MF A01.

In order to determine the influence of the temperature on the crack arrest toughness, investigations were concluded with three pressure-vessel steels - 20 MnMoNi 55 (KS17), 22 NiMoCr 37 (KS07 A/B) and 17 MoV 84 (KS22) - of various strengths and toughness up to the plateau region of the notched-bar impact work functions. The tests were conducted on the basis of the ASTM-draft standard for ferritic materials on modified transversally wedge-loaded compact specimens 170 mm thick and up to 400 mm long. A comparison between the results and the reference curves of the published American and German standards (ASME III, ASME XI and KTA 3201.2) has shown significant deviations at elevated temperatures.

33878 (INIS-mf–11982, pp. 9.1-9.20) **Characteristic experimental data for evaluating the fracture toughness of impact loaded medium-scale specimens.** Becker, K.E. (Technischer Ueberwachungs-Verein Bayern e.V., Muenchen (Germany, F.R.)); Joas, H.D.; Meyer, A.R.; Schmitt-Thomas, K.G. Staatliche Materialpruefungsanstalt, Stuttgart (Germany, F.R.); Technischer Ueberwachungs-Verein Bayern e.V., Muenchen (Germany, F.R.); Technische Univ. Muenchen (Germany, F.R.). 1987. (In German). (CONF-8710410–: 13. MPA seminar on safety and reliability of pressure components: the contribution of component and large specimen testing to structural integrity assessment methodology, Stuttgart, Germany, F.R., 8-9 Oct 1987). In *Safety and reliability of pressure components with special emphasis on the contribution of component and large specimen testing to structural integrity assessment methodology. Vol. 1. Fracture mechanics, dynamic loading, nondestructive testing, radiation embrittlement.* Order Number DE89783126/JAW. Available from NTIS (US Sales Only), PC A99/MF A01.

A new technique developed with the aid of experimental stress analysis for medium-scale notched impact-loaded specimens delivers information concerning the fracture process in the form of a force-time diagram. The combination of metrology and fractography is applied in connection with the strain rate and the fracture stress determined with medium-scale notched specimens in conjunction with the interval $(t_i + t_i I)$ up to F_{max} or $F_{unstable}$. This delivers a concept which describes the temperature-conditional effect of comparibly rapidly applied loads on the risk of component failure (just prior to unstable crack propagation) for component-similar specimens. Although the characterization of the material behaviour in the ductile/brittle transition zone of the toughness for shock loading is - as far as the statistical fracture resistance is concerned - conservative, it nevertheless remains inadequate.

33879 (INIS-SU–80, pp. 26-30) **Intensity of dislocation sinks in nickel.** Golubov, S.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (USSR). Fiziko-Ehnergeticheskij Inst.); Konobeev, Yu.V.; Rudnev, S.I.; Strokova, A.M. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. (In Russian). In *Physics of radiation defects and radiation materiss science. Scientific-technical collection.* Order Number DE89012114/JAW. Available from NTIS (US Sales Only), PC A05/MF A01; INIS.

Voprosy atomnoj nauki i tekhniki.; no. 3(41).

During irradiation of nickel thin foils with 50 keV Ni^+ ions the point defects are generated in ~ 30 nm width near-the-surface layer and, congruently, the foil surface is the dominating sink of vacancies and interstitial atoms. To take account of the foil boundaries of nonuniform generation profile solution of diffusion equations, aimed at determining intensity of dislocation sinks and preference factor, from the experimental data on the swelling rate, mean diameter, density of vacancy voids and of dislocations obtained for 450, 550, 600 and 650 deg C irradiation temperatures, is carried out. 8 refs.; 3 figs.; 1 tab.

33880 (INIS-SU–80, pp. 31-36) **Mechanism of rupture of island films by multicharged high-energy particles.** Natsik, V.D. (AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst. Nizkikh Temperatur); Bormashenko, Eh.Yu. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. (In Russian). In *Physics of radiation defects and radiation materiss science. Scientific-technical collection.* Order Number DE89012114/JAW. Available from NTIS (US Sales Only), PC A05/MF A01; INIS.

Voprosy atomnoj nauki i tekhniki.; no. 3(41).

Mechanisms of rupture of metallic island film sprayed onto dielectric strate by muticharged high-energy particles are discussed. The energy absorbed by the island conductivity electrons during its collision with a particle is estimated, criterion of island evaporation is determined. Pulse of Rayleigh waves excited by particle track on the substrate surface is described and criterion of the island separation from sublattice under the pulse effect is indicated. 11 refs.; 3 figs.

33881 (INIS-SU–80, pp. 51-56) **Bound strength between gas pores and grain boundaries in copper and nickel.** Farkhutdinov, K.G. (AN Kazakhskoj SSR, Alma-Ata (USSR). Inst. Yadernoj Fiziki). Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. (In Russian). In *Physics of radiation defects and radiation materiss science. Scientific-technical collection.* Order Number DE89012114/JAW. Available from NTIS (US Sales Only), PC A05/MF A01; INIS.

Voprosy atomnoj nauki i tekhniki.; no. 3(41).

Bonding force between helium and hydrogen gas voids and grain boundaries in copper and nickel samples subjected to α-particle and proton irradiation is investigated. It is shown that in copper the bonding force of helium voids above 0.5 μm and grain boundaries is much more than that of similar size hydrogen pores. It is also stated that bonding force of helium voids below 20 nm and grain boundaries in copper is less than in nickel. On the basis of analysis of the detected differences of bonding forces, depending on the nature of gas-filler and metal, in calculations of the grain void-boundary binding energy the author suggests to take account not only the void size, the ratio between the energies of grain boundary and free surface, but elastic interaction between the matrix atoms and those (molecules) of gas-filler. 21 refs.; 3 figs.

33882 (INIS-SU–80, pp. 68-69) **Combination of backscattering and translucent electron microscopy methods at the research of thin-film samples.** Dzenkovskij, V.G. (AN Ukrainskoj

SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst.); Martynov, I.S.; Rybalko, V.F.; Tolstolutskaya, G.D. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. (In Russian). In *Physics of radiation defects and radiation materiss science. Scientific-technical collection.* Order Number DE89012114/JAW. Available from NTIS (US Sales Only), PC A05/MF A01; INIS.

Voprosy atomnoj nauki i tekhniki.; no. 3(41).

NICKEL/backscattering; NICKEL/physical radiation effects; THIN FILMS/backscattering; ACCURACY; ELECTRON MICROSCOPY; HELIUM IONS; ION IMPLANTATION; MEV RANGE 01-10; NICKEL; BACKSCATTERING; PROTON SPECTRA

33883 (INIS-SU–80, pp. 70-72) **Simulation of radiation damage of the reactor cores steel by using of high-energy e-γ beams.** Gann, V.V. (AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst.); Neklyudov, I.M.; Ozhigov, L.S.; Parkhomenko, A.A.; Gorelov, S.N.; Kiselevskij, V.N. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. (In Russian). In *Physics of radiation defects and radiation materiss science. Scientific-technical collection.* Order Number DE89012114/JAW. Available from NTIS (US Sales Only), PC A05/MF A01; INIS.

Voprosy atomnoj nauki i tekhniki.; no. 3(41).

REACTOR MATERIALS/physical radiation effects; REACTOR MATERIALS/simulation; STEEL-CR2MOV/physical radiation effects; STEEL-CR2MOV/simulation; DUCTILE-BRITTLE TRANSITIONS; ELECTRON BEAMS; EMBRITTLEMENT; FRACTURE PROPERTIES; GAMMA RADIATION; LOW TEMPERATURE; MATERIALS TESTING; NEUTRON FLUENCE; SIMULATION; STEEL-CR2MOV; TEMPERATURE DEPENDENCE; TENSILE PROPERTIES; TRANSITION TEMPERATURE

33884 (INIS-SU–80, pp. 73-75) **Influence of thermal displacements on the defect distribution profile calculated by the pair collision method.** Gann, V.V. (AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst.); Yudin, O.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. (In Russian). In *Physics of radiation defects and radiation materiss science. Scientific-technical collection.* Order Number DE89012114/JAW. Available from NTIS (US Sales Only), PC A05/MF A01; INIS.

Voprosy atomnoj nauki i tekhniki.; no. 3(41).

IRON BASE ALLOYS/physical radiation effects; NICKEL/physical radiation effects; ALUMINIUM IONS; ATOM-ATOM COLLISIONS; DISPLACEMENT RATES; CRYSTAL DEFECTS; HIGH TEMPERATURE; ION IMPLANTATION; KEV RANGE 01-10; KEV RANGE 10-100; NICKEL; NICKEL IONS; SIMULATION; SPATIAL DISTRIBUTION; TEMPERATURE DEPENDENCE

33885 (JAERI-M–88-264) **Influence of Cr/W ratio on corrosion behavior of Ni-Cr-W superalloys in simulated VHTR helium environment.** Tsukada, Takashi; Shindo, Masami; Suzuki, Tomio; Nakajima, Hajime. Japan Atomic Energy Research Inst., Tokyo (Japan). Jan 1989. 44p. (In Japanese). Order Number DE89778128/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

In order to optimize the chemical composition of developmental Ni-Cr-W superalloy for VHTR applications, the influence of Cr/W ratio on corrosion behavior was studied. The test materials have various Cr/W ratio systematically and also contain 1 wt% Mn and 0.3 wt% Si to improve the corrosion resistance in simulated VHTR helium. The corrosion tests were carried out in simulated VHTR helium under the thermal cycling between R.T. and 900, 950 and 1000degC up to 1000 h. The results obtained are summarized as follows, (1) The weight gain of specimens and the spallation of surface oxide film were less on the alloys with low Cr contents (high W contents). The alloys contained Cr below 20 wt% showed the good oxidation resistance. (2) The thickness of surface film and the depth of internal oxidation decreased with decreasing the Cr content of the alloys. (3) At 900degC and 950degC all alloys were carburized. The decarburization was observed in the alloys with Cr content below 20 wt% at 1000degC. (4) The heat treatments for the soild solution or grain boundary precipitated not influence on the corrosion behaviors. (5) The surface films were consisted of two layers which were the outer $MnCr_2O_4$ spinel oxide layer and the inner Cr_2O_3 oxide layer. The oxidation resistance of the alloys were improved by the addition of Mn.

33886 (JINR–18-88-439) **Vanadium radiation-annealing hardening.** Gomozov, L.I.; Zvereva, T.N.; Didyk, A.Yu.; Sashin, I.L.; Skuratov, V.A. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions. 1988. 12p. (In Russian). Order Number DE89619605/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Submitted to Fiz. Mat. Metalloved.

The mechanical properties of vanadium irradiated by fast neutron up to the dose $8.6x10^{-4}$ dpa are studied as a function of the post-irradiation annealing temperature. It is shown, that the radiation-annealing hardening (RAH) are observed at the 300 deg C temperature, and it agrees with earlier investigation. For the first time it is established, that RAH is accompanied by decreasing of the plastic properties. The phenomenological model, explained the dependence RAH on the dose and temperature irradiation and on maintenance of active impurities are suggested. 14 refs.; 7 figs.; 1 tab.

33887 (JINR-R–14-88-440) **Peculiarity radiation swelling of copper irradiated by xenon and copper ions with energy 1 MeV/a.m.u.** Vagin, S.P.; Reutov, V.F.; Chakrov, P.V.; Didyk, A.Yu.; Skuratov, V.A. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions. 1988. 12p. (In Russian). Order Number DE89619604/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Submitted to the journal Zh. Tekh. Fiz.

The copper radiation swelling irradiated by xenon (with 124 MeV energy) and copper (with 63 MeV energy) heavy ions is studied. The temperature and dose dependences of the radiation swelling quantity are obtained. The position of the temperature swelling maximum in the case of copper ion irradiation agrees with earlier experimental data. The estimation of vacancies migration activation energy is carried out. It is shown that in the case of irradiation by xenon ions the temperature displacement of swelling maximum is observed. The phenomenological model describing this behaviour is suggested. 10 refs.; 10 figs.

33888 (LBL–26168) **Microstructural evolution of Al-Li and Al-Li-Cu-Mg alloys.** Miyasato, S.; Thomas, G. Lawrence Berkeley Lab., CA (USA). Mar 1989. 11p. Sponsored by DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-8903109–5: 5. international aluminum-lithium conference, Williamsburg, Virginia, USA, 28-31 Mar 1989). Order Number DE89012981/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Since subsequent microstructures and properties depend upon initial decomposition processes, the early developments in a binary Al-Li and quaternary Al-Li-Cu-Mg alloy were observed by high resolution transmission electron microscopy. Interpretation of high resolution images involved appropriate image simulations. The as-quenched microstructure was found to consist of small ordered domains which were unaffected by the presence of Cu and Mg alloying additions, B′ (Al_3Zr) dispersoids and grain boundaries, and are thus interpreted as forming by spinodal decomposition. The ordered domains, ~4 nm in diameter, were often observed in antiphase with each other and were separated by regions of disordered matrix. No discrete δ' (Al_3Li) particles were observed for natural aging times between 24 hours and 3 weeks.

33889 (LBL–26651) **Cryogenic tensile properties of AA 2090 weldments.** Sunwoo, A.J.; Morris, J.W. Jr. Lawrence Berkeley Lab., CA (USA). Mar 1989. 12p. Sponsored by DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-8903109–4: 5. international aluminum-lithium conference, Williamsburg, Virginia, USA, 28-31 Mar 1989). Order Number DE89012979/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The influence of base metal temper and filler metal additions on the cryogenic properties Al-Li 2090 weldments are studied. The results show that as the strength of the base metal increases, strength mismatch increases and the joint efficiency decreases. Inhomogeneous deformation is confined to the fusion zone and the strain localization results in premature failure in the weldment. As the temperature decreases, T3 base metal weldments show better properties than T8 base metal weldments. The influence of filler metal additions on the weldment properties shows that the strength is limited without post-weld aging, but the increase in elongation is significant. At 77 K, a 6 Cu addition to 2090 yields the best UTS and elongation combination of the filler metals studied. Mg addition leads to embrittlement at 77 K. 14 refs., 4 figs.

33890 (LBL–27064) **A method for generating the J_c, B, T surface for niobium-alloy superconductors.** Green, M.A. Lawrence Berkeley Lab., CA (USA). Mar 1989. 12p. Sponsored by DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-8902100–2: TMS symposium on high temperature superconductors, Las Vegas, Nevada, USA, 27 Feb - 3 mar 1989). Order Number DE89012977/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This report shows how the J_c, B, T surface can be created for various niobium-alloy superconductors using a reduced critical state model. Using this method, one can calculate the J_c of the superconductor over a range of B and T given the J_c at 4.2 K over a limited range of B. The calculated value of J_c agrees favorably with measured values over a range of temperatures from 1.5 to 7.0 K and a range of inductions from 0.1 to B_{c2}. This method has been applied to various niobium-titanium-alloys, niobium-zirconium and niobium-tantalum-titanium. The paper compares calculated values of J_c with measured values of J_c for niobium-alloy superconductors manufactured since 1965. As an illustration, a computer generated J_c, B, T surface is presented for some of the superconductors. 15 refs., 10 figs.

33891 (MU/FEAS–1988) **Evaluation of relative effect of natural and synthetic seawaters in corrosion fatigue of steel welded joints.** Manahan, C.C.; Hopkins, R.M. Memorial Univ. of Newfoundland, St. John's, NF (Canada). Faculty of Engineering and Applied Science. 1988. 61p. (MICROLOG–88-05009). Available from Canada Centre for Mineral and Energy Technology, Technical Information Division, 555 Booth St., Rm. 342, Ottawa, , Canada K1A 0G1; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Experiments were designed to investigate the relative severity of natural and ASTM substitute ocean waters when used with cathodically protected steel samples. The investigation was conducted using three types of specimens: welded T-plates, compact type (CT) specimens, and artificial crevices. Welded T-plates provided data on the initiation and propagation behavior of semi-elliptical cracks. CT specimens were tested to obtain crack growth rate versus crack tip stress intensity range data, since it is difficult to derive similar curves from welded T-plate data. The artificial crevice experiments were combined with polarographic and scanning electron microprobe analyses to study the chemistry of calcareous deposits and their influence on water reduction kinetics. Magnesium rich deposits were less effective in reducing the rate for water reduction than were calcium rich deposits. For the intermediate levels of crack tip stress intensity range examined using CT specimens, the two solutions produced similar crack growth rate data. Crack propagation rates were generally between 2 and 2.5 times faster under cathodic protection in seawater than in air. Significantly different fatigue behaviors were observed for the welded T-plates. Fatigue cracks initiated early within the specimens tested in natural seawater, but propagated at rates close to those observed in air. Synthetic seawater prolonged the initiation phase but gave rise to crack propagation rates that were about 2 times higher than those observed in air. These results have been explained in terms of the properties and precipitation kinetics of calcareous deposits. 27 refs., 19 figs., 6 tabs.

33892 (N–89-16967) **Combustibility of titanium powders.** Popov, YE.I.; Poyarkov, V.G.; Finayev, YU.A. National Aeronautics and Space Administration, Washington, DC (USA). Feb 1989. 6p. Transl. into ENGLISH from Vosplamenyayemost Poroshkov Titana, Izvestiya Akademiyi Nauk BSSR, No. 2, 1975, (91-92). (NASA-TT–20455;NAS–1.77:20455). Available from Issuing Activity.

The combustion of compact samples was studied; the mechanism of autoignition is defined. Several studies are made of the combustibility of titanium using 50 samples. The data provide a clear idea of the combustibility of titanium powders.

33893 (NUREG/CP–0075, pp. 13-32) **Solution to the workshop problem using the CEGB fracture assessment procedure [R6].** Ainsworth, R.A. (Berkeley Nuclear Labs., Gloucestershire (England)); Chell, G.G.; Milne, I. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering; Oak Ridge National Lab., TN (USA); Organization for Economic Co-Operation and Development, 75 - Paris (France); Southwest Research Inst., San Antonio, TX (USA). May 1988. (CONF-8406371–: CSNI/NRC workshop on ductile piping fracture mechanics, San Antonio, Texas, USA, 21-22 Jun 1984;CSNI–97). In *CSNI/NRC workshop on ductile piping fracture mechanics: Proceedings.* Order Number DE88013250/JAW. Available from NTIS, PC A08/MF A01 - I.

The workshop problem has been specified as a large diameter stainless steel pipe with a part-circumferential through-wall crack. The pipe is subjected to a constant axial stress and an increasing bending moment. This paper presents a standard R6 solution to define the bending moments at crack initiation and load controlled instability using the failure assessment line developed for materials with a high capacity for work hardening. An addendum briefly describes the background to the R6 approach and its validation for stainless steels. The addendum also uses the R6 procedure to derive additional information about the workshop problem and illustrates the sensitivity of the problem to the input material deformation data.

33894 (NUREG/CP–0075, pp. 33-48) **Sensitivity analysis of flaw growth instability.** Okamoto, A. (Electric Power Research Institute, Palo Alto, CA (USA)); Norris, D.M. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering; Oak Ridge National Lab., TN (USA); Organization for Economic Co-Operation and Development, 75 - Paris (France); Southwest Research Inst., San Antonio, TX (USA). May 1988. (CONF-8406371–: CSNI/NRC workshop on ductile piping fracture mechanics, San Antonio, Texas, USA, 21-22 Jun 1984;CSNI–97). In *CSNI/NRC workshop on ductile piping fracture mechanics: Proceedings.* Order Number DE88013250/JAW. Available from NTIS, PC A08/MF A01 - I.

A solution is presented to the CSNI workshop problem. The authors describe parametric studies that test the sensitivity of the instability load to constants of the Ramberg-Osgood stress-strain description, the J resistance curve, and the crack and pipe geometry. The assumption of linear interaction line for combined tension and bending is checked with new solutions. They compare failure analysis diagram solutions with an analogous graphic procedure in J-T space, and with a graphic method based only on J-Load space. The three solution methods gave about the same instability loads. The solution of the CSNI problem showed that the tearing instability load is higher for the lower toughness weldment material than for the tough base metal. This is probably due to an inappropriate base material description. The authors find that the instability load increases with material strength and is more sensitive to changes in this strength than to equivalent changes in the J resistance curve. Finally, comments are given on appropriate fitting ranges for stress - strain data.

33895 (NUREG/CP–0075, pp. 49-75) **Deformation plasticity failure assessment diagram approach.** Bloom, J.M. (Babcock and Wilcox Co., Alliance, OH (USA)). Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering; Oak Ridge National Lab., TN (USA); Organization for Economic Co-Operation and Development, 75 - Paris (France); Southwest Research Inst., San Antonio, TX (USA). May 1988. (CONF-8406371–: CSNI/NRC workshop on ductile piping fracture mechanics, San Antonio, Texas, USA, 21-22 Jun 1984;CSNI–97). In *CSNI/NRC workshop on ductile piping fracture mechanics: Proceedings.* Order Number DE88013250/JAW. Available from NTIS, PC A08/MF A01 - I.

There are several methods which can be used to address ductile tearing of cracked piping. The CSNI/NRC Ductile Piping Fracture Mechanics Workshop problem is readily adaptable, in particular to

the deformation plasticity failure assessment diagram (DPFAD) approach. This approach can easily be used for the prediction of instability of nuclear piping containing simple through-wall cracks as given in the workshop problem. In essence, the DPFAD approach recognizes both brittle fracture and net section collapse of a flawed structure and is given in the form of a safety/failure plane defined by the stress intensity factor/fracture toughness ratio as the ordinate and the applied stress/net section plastic collapse stress ratio as the abscissa. For a particular stress level and defect size, these coordinates can be readily calculated. If the calculated assessment point lies inside the failure assessment curve, no crack growth can occur. If the assessment point lies on the curve, stable crack growth is possible. If the assessment point lies outside the curve, unstable crack growth and failure is predicted.

33896 (NUREG/CP–0075, pp. 76-105) **Ductile piping fracture mechanics.** Wilkowski, G.M. (Battelle Columbus Labs., OH (USA)); Broek, D.; Nakagaki, M.; Pan, J. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering; Oak Ridge National Lab., TN (USA); Organization for Economic Co-Operation and Development, 75 - Paris (France); Southwest Research Inst., San Antonio, TX (USA). May 1988. (CONF-8406371–: CSNI/NRC workshop on ductile piping fracture mechanics, San Antonio, Texas, USA, 21-22 Jun 1984;CSNI–97). In *CSNI/NRC workshop on ductile piping fracture mechanics: Proceedings.* Order Number DE88013250/JAW. Available from NTIS, PC A08/MF A01 - I.

The objective of this Workshop's calculational exercises falls within the scope of the NRC Degraded Piping Program - Phase II, presently being conducted by Battelle. Since Battelle's approach to the workshop problem is governed and dictated by this program, a summary of the program is given below. The problem and method of analysis is then described. The solution is discussed. The lack of an absolute measure against which to compare the results, in the form of a test result, further complicates the judgment of the results. As shown by the sensitivity study presented here, a finite element analysis lacks the quality of an absolute measure. In view of this, the solution to the workshop problem presented here is considered of value only in that it shows what was already known; namely, that further development of estimation schemes for practical application is necessary. The actual solution obtained is based on assumptions to which Battelle does not necessarily subscribe, but which had to be made for lack of proven alternatives in order to obtain a solution at all at this stage in time. Although assumptions will always be necessary, better and more reliable methods will be developed and experimentally verified in the course of the NRC Program.

33897 (NUREG/CP–0075, pp. 106-112) **J-integral analysis of a circumferentially cracked pipe subjected to bending loads.** Packeiser, R. (Bundesanstalt Fur Materialprufung, Berlin (West Germany)); Brocks, W.; Aurich, D. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering; Oak Ridge National Lab., TN (USA); Organization for Economic Co-Operation and Development, 75 - Paris (France); Southwest Research Inst., San Antonio, TX (USA). May 1988. (CONF-8406371–: CSNI/NRC workshop on ductile piping fracture mechanics, San Antonio, Texas, USA, 21-22 Jun 1984;CSNI–97). In *CSNI/NRC workshop on ductile piping fracture mechanics: Proceedings.* Order Number DE88013250/JAW. Available from NTIS, PC A08/MF A01 - I.

A modified Dugdale solution is used for the calculation of the J-integral for a pipe subjected to axial force and bending moment at the same time. Definitions, equations, and assumptions are explained. The value of initiation toughness was defined is two different ways. The predicted bending moment ratio at instability was found to be 0.99, so that the pipe will fail when the collapse moment has nearly been reached.

33898 (NUREG/CP–0075, pp. 113-121) **Closed form expressions for fracture mechanics analysis of cracked pipes.** Zahoor, A. (NOVETECH Corp., Rockville, MD (USA)). Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering; Oak Ridge National Lab., TN (USA); Organization for Economic Co-Operation and Development, 75 - Paris (France); Southwest Research Inst., San Antonio, TX (USA). May 1988. (CONF-8406371–: CSNI/NRC workshop on ductile piping fracture mechanics, San Antonio, Texas, USA, 21-22 Jun 1984;CSNI–97). In *CSNI/NRC workshop on ductile piping fracture mechanics: Proceedings.* Order Number DE88013250/JAW. Available from NTIS, PC A08/MF A01 - I.

Closed form stress intensity factor (K_I) expressions are presented for cracks in pipes subjected to a variety of loading conditions. The loadings considered are: (i) axial tension, (ii) remotely applied bending moment, and (iii) internal pressure. Expressions are presented for circumferential and axial cracks, and include both part-through and throughcrack geometries. The closed form K_I expressions are valid for pipe radius to wall thickness ratio between 5 and 20. In addition J and T expressions suitable for tearing instability analysis are presented for circumferential through cracks under combined tension and bending. This latter expression is valid for contained yielding applications.

33899 (NUREG/CP–0075, pp. 122-146) **Elastic-plastic finite element analyses of circumferentially cracked pipe geometries.** Cardinal, J.W. (Southwest Research Institute, San Antonio, TX (USA)); Polch, E.Z.; Nair, P.K.; Kanninen, M.F. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering; Oak Ridge National Lab., TN (USA); Organization for Economic Co-Operation and Development, 75 - Paris (France); Southwest Research Inst., San Antonio, TX (USA). May 1988. (CONF-8406371–: CSNI/NRC workshop on ductile piping fracture mechanics, San Antonio, Texas, USA, 21-22 Jun 1984;CSNI–97). In *CSNI/NRC workshop on ductile piping fracture mechanics: Proceedings.* Order Number DE88013250/JAW. Available from NTIS, PC A08/MF A01 - I.

Detailed elastic-plastic finite element fracture mechanics analyses were conducted for the evaluation of the workshop problem. The purpose of these analyses was to provide reasonable benchmark solutions to help assess the various approximate elastic-plastic analyses presented at the CSNI meeting. Calculations were performed to analyze (1) the monolithic base metal pipe, and (2) the welded pipe treated as a composite of base metal and weldment. In the latter, each constituent was assigned distinct mechanical and fracture properties. In both solutions applied J values were calculated for a constant axial load and increasing values of applied bending moment. The material J-resistance curves were used to initiate and grow the initial crack in a stable manner with fracture instability occurring under load control.

33900 (PB–89-148399/XAB) **Institute for Materials Science and Engineering, Fracture and Deformation Division: technical activities, 1988.** McHenry, H.I. National Inst. of Standards and Technology (IMSE), Boulder, CO (USA). Fracture and Deformation Div. Oct 1988. 85p. (NISTIR–88/3841). Available from NTIS, PC A05/MF A01.

See also report for 1987, PB–88-153622.

This report describes the 1988 fiscal-year programs of the Fracture and Deformation Division of the Institute for Materials Science and Engineering. It summarizes the principal accomplishments in three general research areas: materials performance, properties, and processing. The Fracture Mechanics, Fracture Physics, Nondestructive Evaluation, and Composite Materials Groups work together to detect damage in metals and composite materials and to assess the significance of the damage with respect to service performance. The Cryogenic Materials and Physical Properties Groups investigate the behavior of materials at low temperature and measure and model the physical properties of advanced materials, including composites, ceramics, and the new high-critical-temperature superconductors. The Welding and Thermomechanical Processing Groups investigate the nonequilibrium metallurgical changes that occur during processing and affect the quality, microstructure, properties, and performance of metals. The report lists the division's professional staff, their research areas, publications, leadership in professional societies, and collaboration in research programs with industries and universities.

33901 (PPA-T–71) **Creep-rupture properties of type 304 austenitic stainless steel at elevated temperatures.** Zulkifli Ahyak; Esah Hamzah; Abdul Aziz Mohamad. Unit Tenaga Nuklear, Bangi, Selangor (Malaysia). Aug 1987. 15p. Order Number DE89617929/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The creep behaviour of a type 304 stainless steel has been examined at temperatures of 450 to 750 ^{0}C under uniaxial initial

stress of 200 Mpa. It was found that carbide precipitation within grain boundary, recrystallization and grain growth occured during creep at above 550 ^{0}C. It is apparent that the creep-resistant of the steel is influenced by grain boundaries.

33902 (RAL–89-015) **On the mass and width of the lower scalar glueball.** Bordes, J.; Gimenez, V.; Penarrocha, J.A. Rutherford Appleton Lab., Chilton (UK). Jan 1989. 13p. (FTUV–04/89). Order Number DE89619580/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

We use Laplace sum rules to find the values of masses and widths of the lowest scalar glueball compatible with the present knowledge of the vacuum condensates. Our results favour the existence of a light ($M < \sim 0.7$ GeV) and narrow ($\Gamma < \sim 0.06$ GeV) lowest scalar glueball. As a byproduct we estimate the value of the eight dimension condensate, the result being in contradiction with the one obtained using the vacuum saturation hypothesis.

33903 (SAND–89-0683C) **Quantitative thin film x-ray microanalysis of Nb modified Ti_3Al.** Romig, A.D. Jr.; Headley, T.J.; Carr, M.J.; Cieslak, M.J. Sandia National Labs., Albuquerque, NM (USA). 1989. 9p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890748–7: Microbeam Analysis Society meeting, Asheville, North Carolina, USA, 16-21 Jul 1989). Order Number DE89009946/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Advanced titanium-aluminum intermetallic alloys (often simply called titanium aluminides) have certain properties which make them potentially attractive as advanced aerospace alloys. In order to utilize these alloys in engineering applications, it is necessary to process the alloys in a variety of ways including casting, hot forming and welding. All of these processes modify the microstructure of the alloy, which in turn directly influences the properties. The key to optimizing the alloy's properties is to control the microstructure by careful control of the processing parameters. Control for the microstructure requires a thorough understanding of the evolution of the microstructure, including elemental partitioning between the various phases which form in the alloy. Analytical electron microscopy (AEM) is an ideal way to characterize the microstructures on a fine spatial scale. Such high spatial resolution microanalysis is required to understand the microstructural evolution in these alloys. In this case, the alloy is a Nb modified Ti_3Al, and the partitioning behavior of interest is between a variety of ternary phases which are produced as a function of alloy cooling rate from a single homogeneous high temperature β phase. The Nb is added to the alloy to enhance its performance, primarily through an improvement in ductility. In this work, the details of the procedure for quantitative analysis of these alloys are presented.

33904 (SAND–89-0843) **An initial investigation of the ultrasonic welding of Tophet C bridgewire to Hastelloy C-276.** Knorovsky, G.A.; Kwiatkowski, J.J. Sandia National Labs., Albuquerque, NM (USA). May 1989. 15p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. Order Number DE89012864/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

An initial feasibility study has been completed on the ultrasonic welding of Tophet C (Ni-24 Fe-16 Cr) bridgewire to Hastelloy C-276 (Ni-16 Cr-15 Mo-4 W) pin material. A key feature of this work is that it employed a hybrid microcircuitry ultrasonic wire bonder. Much greater productivity can be expected from this process compared with traditional bridgewire welding methods. Three different ultrasonic tool designs were investigated. After selection of the best design, pull test data were acquired for both the 1st and 2nd weld locations in both heel and toe directions. Values up to 94% of the bridgewire tensile strength were obtained. With the equipment used both raised and flat bridgewire configurations are possible. While much work is still necessary to prove in the process for production applications, the work completed to date indicates the ultrasonic welding process merits further investigation. 6 figs.

33905 (SKB-TR–88-17) **On the corrosion of copper in pure water.** Eriksen, T.E.; Ndalamba, P.; Grenthe, I. Swedish Nuclear Fuel and Waste Management Co., Stockholm (Sweden). Mar 1988. 20p. Order Number DE89617947/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Due to a remarkable publication by Hultquist questioning well known thermodynamic data the corrosion of copper in distilled water has been studied. No hydrogen evolution was observed during an exposure period of 61 days using a gaschromatographic technique. Cu_2O was the only corrosion product detected by means of ESCA and cathodic reduction. The corrosion rates obtained for two different qualities are much lower than corrosion rate measured in the study by Hultquist and is ascribed to the reaction between the copper foils and rest oxygen initially present in the water. In conclusion the present investigation confirmed well established thermodynamics, which means that oxidation of copper by pure deoxygenated water under the formation of hydrogen as proposed by Hultquist is not thermodynamically feasible. (authors).

33906 (UCRL–97917-Rev.1) **Stress corrosion cracking of uranium-silver interfaces in silver-aided diffusion welds: Revision 1.** Rosen, R.S.; Beitscher, S.; Kassner, M.E. Lawrence Livermore National Lab., CA (USA). 17 May 1989. 17p. Sponsored by DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-8810330–2-Rev.1: International conference on environment-induced crack growth of metals, Kohler, Wisconsin, USA, 5 Oct 1988). Order Number DE89013788/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

We have studied stress corrosion cracking in weld specimens in which uranium and Type 304 stainless steel were joined by an autoclave diffusion weld method using silver as an intermediate layer. The specimens were placed in bend-test fixtures, which applied tensile stresses normal to the butt joints, in either laboratory air or in air saturated with water vapor. Those stressed in laboratory air at 1/2 of the ultimate strength exhibited ductile creep rupture predominately at the Ag-Ag diffusion weld interface after more than 20 days, whereas those stressed in saturated water vapor at the same load exhibited cracking predominately at the U-Ag interface after only a few days. Similar specimens exposed to saturated water vapor for up to 37 days in an unstressed condition exhibited no evidence of interfacial corrosion. Other weld specimens were prestrained so as to establish residual shear stresses in the joints, and then were stored for 4 years in polyethylene bags that were permeable to water vapor. Other unstrained specimens were stored in an identical environment. After 4 years, the prestrained specimens showed stress corrosion cracking at the U-Ag interfaces, whereas the specimens that had not been prestrained showed no evidence of interfacial corrosion. Thus, U-Ag weld interfaces have been demonstrated to be susceptible to stress corrosion cracking under both tensile and shear loading. 13 refs., 2 figs., 3 tabs.

33907 Oxidation of metals and associated mass transport. Dayananda, M.A.; Rothman, S.J.; King, W.E. 344p. The Metallurgical Society Inc., Warrendale, PA (1987). (CONF-861076–: Fall meeting of the Metallurgical Society of AIME, Orlando, Florida, USA, 5-9 Oct 1986).

These proceedings collect papers on metal oxidation. Topics include: the effect of reactive elements on cation self-diffusion, stresses in oxide films, cracking, spalling, AES, XPS, RBS, NRA and Laser Raman studies of corrosion, and the effect of yttrium ion implantation on oxide growth kinetics.

33908 Characterization of defects in materials. Materials Research Society symposia proceedings. Volume 82. Siegel, R.W.; Weertman, J.R.; Sinclair, R. 532p. Materials Research Society, Pittsburgh, PA (1987). (CONF-861207–: Materials Research Society fall meeting, Boston, Massachusetts, USA, 1-5 Dec 1986).

This book contains over 50 selections. Some of the titles are: Nuclear reaction spectroscopy of vibrational modes of solids; X-ray diffuse scattering from cobalt precipitates in copper; Theoretical studies of defects in binary and ternary oxides; and Accurate interatomic potentials for Ni, Al and Ni_3Al.

33909 Corrosion of Fe-25Cr-20Ni alloy in molten alkali carbonates. Hsu, H.S. (Oak Ridge National Lab., Oak Ridge, TN (US)); Howell, M. v.v of Proceedings of the 1987 Electrochemical Society spring meeting: Extended abstracts. Volume 87-1. The Electrochemical Society, Pennington, NJ (1987). (CONF-870560–: 171. Electrochemical Society meeting, Philadelphia, Pennsylvania, USA, 10-15 May 1987).

In order to identify potential candidate materials for current collectors in molten carbonate fuel cells (MCFCs), mechanistic studies of the corrosion of high temperature alloys by carbonate salt were essential. The authors' previous work had included (1) identification of corrosion products from the reaction of pure metals under fuel cell operating conditions, (2) measurement of equilibrium solubilities of corrosion products in the carbonate mixture, and (3) mechanistic studies of carbonate corrosion of chromium and iron at 650°C. The objective of the present work was to study kinetics and mechanisms of corrosion of Fe-25Cr-20Ni by carbonate salt, $(Li_{0.62}K_{0.38})_2CO_3$ under simulated fuel cell environments at 650°C. Since type 310 stainless steel was found to have relatively good corrosion resistance under fuel cell operating conditions, the Fe-25Cr-20Ni ternary alloy (M310 stainless steel) was used to simulate the composition of type 310 stainless steel. The experiment gas environments were 20% O_2-10% CO_2-Ar, 0.1% O_2-10% CO_2-Ar, and 0.35% CO-10% CO_2-Ar, with and without the addition of 3% H_2O. These environments simulate the oxidant gas, the intermediate oxygen-partial-pressure gas, and the fuel gas, respectively.

33910 Corrosion of low-nickel weldments in coal gasification atmospheres. Natesan, K. (Argonne National Lab., Argonne, IL (US)). v.v of Corrosion '85. National Assoc. of Corrosion Engineers, Houston, TX (1985). (CONF-850311–: National Association of Corrosion Engineers annual meeting and materials performance and corrosion show, Boston, Massachusetts, USA, 25-29 Mar 1985).

Coal gasification environments exhibit low oxygen and moderate-to-high sulfur partial pressures: under these conditions, structural alloys welded with high-nickel filler metals are susceptible to sulfidation mode of attack even though the base metal itself has adequate resistance to sulfidation. To minimize this problem, weldments of incoloy 800H base metal welded with several low-nickel filler metals have been examined in simulated coal gasification atmospheres. Results on both the compositional variations and morphological developments obtained from exposed specimens are presented.

33911 Corrosion-erosion rates/mechanisms of Cr steels. Levy, A.V. (Univ. of California, Berkeley, CA (US)); Jee, N. v.v of Corrosion '85. National Assoc. of Corrosion Engineers, Houston, TX (1985). (CONF-850311–: National Association of Corrosion Engineers annual meeting and materials performance and corrosion show, Boston, Massachusetts, USA, 25-29 Mar 1985).

Surface recession rates of several chromium bearing steels as the result of combined erosion-corrosion in oxygen rich combustion gases are related to the mechanisms which caused the degradation.

33912 The behavior of type 304L stainless steel in tuff repository conditions. Juhas, M.C. (Lawrence Livermore National Lab., Livermore, CA (US)); McCright, R.D.; Garrison, R.E. v.v of Corrosion '85. National Assoc. of Corrosion Engineers, Houston, TX (1985). (CONF-850311–: National Association of Corrosion Engineers annual meeting and materials performance and corrosion show, Boston, Massachusetts, USA, 25-29 Mar 1985).

The Lawrence Livermore National Laboratory is developing containment for high-level nuclear waste as part of the Nevada Nuclear Waste Storage Investigations project. Paper presents results of preliminary findings of sensitization and its effects on the corrosion behavior of the reference material. Type 304L stainless steel. Also discussed are the results of irradiation effects.

33913 Evaluation of intergranular corrosion techniques to determine phosphorus segregation in NiCrMoV rotor steel. Bruemmer, S.M. (Battelle-Pacific Northwest Lab., Richland, WA (US)); Thomas, M.T.; Arey, B.W. v.v of Corrosion '85. National Assoc. of Corrosion Engineers, Houston, TX (1985). (CONF-850311–: National Association of Corrosion Engineers annual meeting and materials performance and corrosion show, Boston, Massachusetts, USA, 25-29 Mar 1985).

Several chemical and electrochemical etching techniques have been evaluated for the indirect measurement of grain boundary phosphorus segregation. A picric acid based solution was found to promote intergranular attack proportional to the grain boundary phosphorus composition measured by Auger Electron Spectroscopy. Preliminary results indicate this solution may enable the nondestructive evaluation of a rotor steel's susceptibility to temper embrittlement and IGSCC.

33914 Dealloying kinetics of silver-gold alloys. Davenport, A.J. (Dept. of Applied Science, Brookhaven National Lab., Upton, NY (US)); Sieradzki, K. v.v of Proceedings of the Electrochemical Society fall meeting. Volume 88-2 (extended abstracts). The Electrochemical Society, Pennington, NJ (1988). (CONF-881061–: Electrochemical Society fall meeting, Chicago, Illinois, USA, 9-14 Oct 1988).

Selective dissolution (dealloying) is often the dominant process in the aqueous corrosion of metal alloys. In this phenomenon, an A_pB_{1-p} alloy immersed in an aggressive environment undergoes a process in which the less noble component (A) is selectively removed from the alloy. Metal-environment systems display sharp compositional dealloying thresholds or parting limits below which only superficial dealloying occurs and above which bulk dealloying is observed. The principle morphological change associated with selective dissolution is the development of a nano-or micro-porous dealloyed layer. The conventional theories of dealloying in a (binary) alloy rely on the following mechanisms: (1) selective dissolution of the less noble metal atoms and aggregation of the more noble metal atoms by surface diffusion: (2) selective dissolution of the less noble metal as transport occurs by divacancy volume diffusion; and (3) dissolution of atoms of both elements followed by redeposition of the more noble metal atoms. None of these theories can explain the existence of sharp dealloying thresholds. The origin of the dealloying thresholds and other aspects of the selective dissolution process are clarified in a new theory of dealloying which is based upon percolation theory. According to this theory, in order for the A atoms to be selectively dissolved from more than just the surface of the alloy, a continuous connected cluster of these atoms must exist. This percolating cluster provides an active path for the dissolution process to occur and also provides a path for the electrolyte to penetrate into the bulk solid.

33915 Transgranular stress-corrosion cracking. Sieradzik, K. (Brookhaven National Lab., Upton, NY (US)). v.v of Proceedings of the Electrochemical Society Fall meeting: Extended abstracts. Volume 87-2. The Electrochemical Society, Pennington, NJ (1987). (CONF-871027–: 172. meeting of the Electrochemical Society, Honolulu, Hawaii, USA, 18-23 Oct 1987).

Sieradzki and Newman have recently proposed a new model of transgranular SCC has been recently proposed based upon the concept of film-induced cleavage, and this is discussed together with new material on the special films that can nucleate cleavage in ductile materials. The concept is that a thin film (surrounding a crack) on the order of nanometers in thickness can induce a microscopically brittle cleavage-like event extending distances on the order of microns into what is normally considered an intrinsically ductile metal. It will be argued that the presence of a film at a crack tip can modify the local deformation mode in such a way as to favor the initiation of cleavage. In this respect the authors are concerned with the film's effectiveness in changing the balance between cleavage and dislocation emission. Recent results of molecular dynamic simulations supporting this notion are discussed. The concept of film-induced cleavage is further supported by analytical calculations which define relationships which must exist between film and substrate in order for this mechanism to operate. The main film and interfacial parameters effecting material behavior are the following: lattice parameter misfit; elastic modulus mismatch; interfacial state of coherency; degree of interfacial bonding; geometric shape of film surrounding crack (determined by film growth kinetics); porosity; intrinsic brittleness or ductility of film.

33916 Molybdenum carbide coating electrodeposited from molten fluoride bath. Topor, D.C. (Dept. of Chemical Engineering, Illinois Institute of Technology, Chicago, IL (US)); Selman, J.R. v.v of Proceedings of the 1987 Electrochemical Society spring meeting: Extended abstracts. Volume 87-1. The Electrochemical Society, Pennington, NJ (1987). (CONF-870560–: 171. Electrochemical Society meeting, Philadelphia, Pennsylvania, USA, 10-15 May 1987).

Molybdenum carbide has been recently considered as a candidate material for the protection of common steel-based substrates in high-temperature high-sulfur activity applications. Methods to produce coatings of materials such as Mo_2C are scarce and only the

electrodeposition from molten salts can yield dense, pore-free layers on various metallic profiles. Recently Stern reported the deposition of a Mo_2C coating on nickel substrate form, FLINAK + K_2MoCl_6 + Na_2CO_3 mixture at 850^{0}C. Electrodeposition of Mo_2C on a cathode surface proceeds according to a rather complicated mechanism which may involve simultaneous reduction of carbonate to C, of molybdate to Mo and a subsequent chemical reaction between both species. The deposit grows further as a coherent coating. Reduction of CO_2 or carbonate to carbon in a fused salt medium could follow different paths but Li^+ ions or other highly polarizing ions must be present. A similar situation in which a polyatomic anion discharges at the cathode is encountered when molybdates are used as source of molybdenum. In fluoride melts the chemistry of Mo(VI) species is considered to be much simpler due to the hard fluoride ions. These ions form strong complexes with molybdenum and the resulting solution is more stable.

33917 Electrochemistry of plutonium in molten halides. McCurry, L.E. (Material Science and Technology Div., Los Alamos National Lab., Los Alamos, NM (US)); Moy, G.M.M.; Bowersox, D.F. v.v of Proceedings of the Electrochemical Society Fall meeting: Extended abstracts. Volume 87-2. The Electrochemical Society, Pennington, NJ (1987). (CONF-871027–: 172. meeting of the Electrochemical Society, Honolulu, Hawaii, USA, 18-23 Oct 1987).

The electrochemistry of plutonium in molten halides is of technological importance as a method of purification of plutonium. Previous authors have reported that plutonium can be purified by electrorefining impure plutonium in various molten haldies. Work to eluciate the mechanism of the plutonium reduction in molten halides has been limited to a chronopotentiometric study in LiCl-KCl. Potentiometric studies have been carried out to determine the standard reduction potential for the plutonium (III) couple in various molten alkali metal halides. Initial cyclic voltammetric experiments were performed in molten KCL at 1100 K. A silver/silver chloride (10 mole %) in equimolar NaCl-KCl was used as a reference electrode. Working and counter electrodes were tungsten. The cell components and melt were contained in a quartz crucible. Background cyclic voltammograms of the KCl melt at the tungsten electrode showed no evidence of electroactive impurities in the melt. Plutonium was added to the melt as $PuCl_3$, which was prepared by chlorination of the oxide. At low concentrations of $PuCl_3$ in the melt (0.01-0.03 molar), no reduction wave due to the reduction of Pu(III) was observed in the voltammograms up to the potassium reduction limit of the melt. However on scan reversal after scanning into the potassium reduction limit a new oxidation wave was observed.

33918 Electrochemical reactions at the electrode in submerged arc welding. Frost, R.H. (Argonne National Lab., Chemical Technology Div., Materials Science and Technology Program, Argonne, IL (US)); Kim, J.H.; Olson, D.L.; Blander, M. v.v of Proceedings of the Electrochemical Society Fall meeting: Extended abstracts. Volume 87-2. The Electrochemical Society, Pennington, NJ (1987). (CONF-871027–: 172. meeting of the Electrochemical Society, Honolulu, Hawaii, USA, 18-23 Oct 1987).

The submerged arc welding process consists of a consumable electrode, an electrically conducting slag and a work piece. The process is complex and characterized by large currents, large gradients of temperature, and four complex phases. The flux is fed to the plate surface ahead of the weld, and the arc and weld pool are protected from the atmosphere by a molten flux layer. The welding current is carried largely by the submerged arc and to some extent by conduction in the molten flux layer. The overall composition of the weld is controlled by the composition of the metal droplets which enter the weld pool, by the amount of dilution of the weld pool by the parent plate, and by electrochemical and thermochemical reactions at metal/slag interfaces. Few investigators have considered the electrochemical reactions that occur when direct current is used in welding. The most important chemical considerations for submerged arc welding include the control of oxygen, oxidation losses of alloy elements, and the pickup of undesirable elements from the slag.

33919 Electrodeposition of microcrystalline chromium from fused salts. Varma, R. (Chemical Technology Div., Argonne National Lab., Argonne, IL (US)); Vargas, T.; Brown, A. v.v of Proceedings of the Electrochemical Society Fall meeting: Extended abstracts. Volume 87-2. The Electrochemical Society, Pennington, NJ (1987). (CONF-871027–: 172. meeting of the Electrochemical Society, Honolulu, Hawaii, USA, 18-23 Oct 1987).

Chromium metal offers good corrosion resistance in a molten sulfur/polysulfide environment and, therefore, constitutes a suitable material for use as a protective coating on current collector grids of the cathode for the sodium/sulfur battery. Coherent and fine-grained coatings of pure chromium that have good adherence (determined by microscopic examination of the chromium-steel interface) to steel substrate have been electrodeposited from (LiCl-KCl (eutectic, m.p. 352^{0}C)-$CrCl_2$ melts at 450^{0}C. This work was involved with the production of chromium coatings from the molten salt electrolyte and their characterization and testing in molten a sulfur/polysulfide medium for chemical stability. In addition, the conditions that control grain size of the electrodeposit were investigated. The electrodeposition experiments were conducted in a helium-environment glove box. The moisture and oxygen content of the inert gas environment were kept at an acceptable minimum (oxygen -10 ppm and moisture -0.2 ppm) level. Stainless steel coupons and chunks of elemental chromium were used as the cathode and anode, respectively. Three potential/current regimes were investigated: (1) nucleating pulse followed by electrodeposition under constant potential, (2) repetitive nucleation and growth pulses, and (3) initial nucleation and periodic reverse pulses. Also the effects of $CrCl_2$ concentration and the mass-transfer limitation in the molten salt on the morphology of the electrodeposit are discussed.

33920 Kinetics of the solid-state amorphizing reaction in thin films studied by electrical resistivity. Rubin, J. B. (Center for Materials Science and MST-7, Los Alamos National Laboratory, Mail Stop K 765, Los Alamos, New Mexico 87545(US)); Schwarz, R. B. *Applied Physics Letters (USA)*, 55(1): 36-38 (3 Jul 1989).

We deposited Ni-Zr thin-film multilayers by electron beam evaporation onto polished alumina substrates. The multilayers were annealed at a constant heating rate, and *in situ* resistance measurements made to derive the growth kinetics of amorphous NiZr alloy at the Ni/Zr interfaces. Using a simple model that relates resistance change to amorphous-layer thickness, we derive the apparent diffusivity of nickel in amorphous $Ni_{50}Zr_{50}$, $D_{Ni} = 2.5 \times 10^{-5} \exp[-1.01(eV)/kT]$ cm^2 s^{-1}.

33921 Nondestructive detection of the T_1 phase in Al-Li alloys. Buck, O. (Ames Lab. - USDOE, Iowa State Univ., Ames, IA (US)); Brasche, L.J.H.; Shield, J.E.; Bracci, D.J.; Jiles, D.C.; Chumbley, L.S. *Scripta Metallurgica (USA)*, 23(2): 183-188 (Feb 1989).

Aluminium-lithium alloys have attracted the interest of aerospace industries for some time now since the use of such alloys reduces the weight of an airframe by roughly ten percent. The production of these alloys, however, requires precise thermal and/or thermomechanical treatments to insure required material properties. Recently, a strong research interest has developed in the use of sensors for monitoring the state of the material during processing and in-service. On Al 2219, combined eddy current (as a measure of electrical conductivity) and hardness measurements were found to be particularly sensitive to the changes occurring during the aging of such alloys. The electrical conductivity, in general, increases with aging. The explanation for this is that the alloying additions in solid solution are very effective in scattering the conduction electrons. As precipitation occurs the resistivity per solute atom decreases, which in turn increases the conductivity. On the other hand, the hardness increases due to precipitation hardening, at least up to peak hardness conditions. Loss of coherency with the matrix and growth of particles reverse the latter trend. In the authors' efforts to characterize the thermal history and the mechanical properties of Al-Li alloy 2090 by NDE techniques, they have noted a strong deviation from the general rule that the conductivity increases with aging. This deviation occurs on samples aged at 200^{0}C for extended periods. Noteworthy is the fact that Al 2219 does not show such a conductivity anomaly with aging. In an attempt to understand this phenomenon, Transmission Electron Microscopy (TEM) was used to determine the morphology and crystal structures of the phases present in appropriate samples.

33922 Transformation plasticity of retained austenite in stage-1 tempered martensitic steels. Cohen, M. (Dept. of Materials Science and Engineering, Massachusetts Institute of Technology, Cambridge, MA (US)); Haidemenopoulos, G.N; , 38500

Volos,; Olson, G.B.; Tsuzaki, K. *Scripta Metallurgica (USA),* 23(2): 207-212 (Feb 1989).

In the present study, controlled experiments were designed to isolate the role of retained austenite and investigate the associated transformation plasticity effects on shear instability, which is the precursor to fracture in these ultrahigh-strength steels. The stability of the retained austenite is the most important parameter controlling its transformation plasticity and toughening effects. The M_s^σ temperature is adopted here as a quantitative characterization of the stability of retained austenite. It is the temperature at which the transformation occurs at the yield stress of the parent phase. Below M_s^σ, the transformation is stress-assisted and nucleation occurs at the same pre-existing nucleation sites responsible for the transformation on cooling. Above M_s^σ, yielding of the austenite by slip generates new nucleation sites and the transformation is strain-induced. The M_s^σ temperature is a function of stress state due to the interaction of the transformation volume change with stress triaxiality. Recent experiments in metastable fully-austenitic steels have demonstrated that transformation plasticity can substantially enhance uniform ductility and toughness when fracture is controlled by shear instability. These property improvements appeared near the corresponding M_s^σ temperatures for the uniaxial tension and crack-tip stress states. It is, therefore, necessary to determine the stress-state dependence of the M_s^σ temperature before assessing the effects of transformation plasticity on mechanical properties.

33923 Theoretical studies of grain boundaries in Ni_3Al with boron or sulfur. Chen, S.P. (Los Alamos National Lab., Los Alamos, NM (US)); Voter, A.F.; Albers, R.C.; Boring, A.M.; Hay, P.J. *Scripta Metallurgica (USA),* 23(2): 217-222 (Feb 1989).

It is well known that grain boundaries (GB) can have pronounced effects on the physical properties of materials (mechanical properties, corrosion resistance, fracture path, resistivity, etc.). Accordingly, a great deal of effort has been devoted to trying to understand the structure, energetics, and properties of grain boundaries. Significant experimental and theoretical progress has been made in understanding grain boundaries in pure systems, while the understanding of grain boundaries in alloy systems is much less developed. Also the mechanical properties of the grain boundaries are not well understood. In the present report, the authors summarize recent results on atomistic simulations of grain boundaries in the $L1_2$ ordered alloy Ni_3Al. Understanding grain boundaries in this material is of particular importance since intergranular fracture limits the applicability of this otherwise promising material. To put these results into perspective, additional simulations were performed on grain boundaries in pure Ni and Al. Many features of grain boundaries in the ordered alloy may be understood in terms of the results on pure Ni and Al grain boundaries. The authors also consider the effect of boron, sulfur, and nickel segregation on the strength of grain boundaries in Ni and Ni_3Al.

33924 A SIMS study of the filling of traps for deuterium in krypton-implanted nickel. Frank, R.C. (Physics Dept., Augustana College, Rock Island, IL (US)); Sucharitsopit, P.D.; Adolphi, N.L.; Baker, J.E.; Baldo, P.; Rehn, L.E. *Scripta Metallurgica (USA),* 22(4): 457-462 (Apr 1988).

A new technique for depth profiling inert-gas atoms in metals using a secondary ion mass spectrometer has provided experimental confirmation of mathematical model simulations of the filling of traps by deuterium diffusing one dimension. The depth profile when traps are being filled by diffusion from one direction has a characteristically steep leading edge, indicating that almost all the traps are filled before the diffusion front moves further into the metal. Annealing at a higher temperature reduces the steep leading gradient, demonstrating that deuterium leaves the completely filled region and diffuses into some of the unfilled traps. At saturation, the depth distribution of the traps which hold deuterium at room temperature matches that of the implanted krypton.

33925 The effect of composition and magnetic heat treatment on the magnetostriction of $Tb_xDy_{1-x}Fe_y$ twinned single crystals. Verhoeven, J. D. (Ames Laboratory and Department of Materials Science and Engineering, Iowa State University, Ames, Iowa 50011(US)); Ostenson, J. E.; Gibson, E. D.; McMasters, O. D. *Journal of Applied Physics (USA),* 66(2): 772-779 (15 Jul 1989). DOE Contract W-7405-ENG-82.

Twinned single crystals of the giant magnetostrictive intermetallic compound $Tb_xDy_{1-x}Fe_y$ with a (112) axial alignment have been prepared by float-zone solidification with Y varying from 1.90 to 1.98 and X being 0.32 or 0.28. The chemical compositions of the crystals were carefully analyzed. A very sharp jump in the magnetostrictive strain λ sometimes occurs in these alloys as the applied field H is increased to values of around 280 Oe under a compressive stress of 6.9 MPa. This large jump in λ is shown to depend strongly on the values of X and Y, and possible reasons for this result are discussed. A magnetic heat treatment has been developed which involves cooling the samples through the Curie temperature under a field applied transverse to the crystal axis. It is shown that this treatment is very effective at increasing the magnetostrictive properties at low applied compressive stresses for certain values of X and Y.

33926 Location of hydrogen adsorbed on palladium (111) studied by low-energy electron diffraction. Felter, T. E. (Sandia National Laboratories, Livermore, California 94551-0969(US)); Sowa, E. C.; Van Hove, M. A. *Physical Review [Section] B: Condensed Matter (USA),* 40(2): 891-899 (15 Jul 1989). DOE Contract AC04-76DP00789.

Low-energy-electron-diffraction (LEED) I-V curves have been measured for H adsorbed on Pd(111) in the $(\sqrt{3} \times \sqrt{3})R30°$-2H structure, which occurs at a coverage Θ=2/3. The measurements are compared to calculations usingdynamical LEED techniques. Twenty-one distinct geometry types wereinvestigated, each one with metal-interlayer relaxations allowed and thedistance of the H atom above (or below) the top Pd layer varied. Themetal-interlayer spacings that we find are within error bars of those of theclean surface. Agreement between theory and experiment was achieved forstructures with one of the two H atoms in the unit mesh in a threefold hollowsurface site, above third-layer metal atoms (denoted "A+"). Thesecond H resides either in the same type of site or in another type ofthreefold site, such as the hollow surface site above second-layer metal atoms$B$+ or the *subsurface* sites between first-andsecond-layer metal atoms, A– or B–. We find that goodreliability factors R are achieved for subsurface occupation fractions upto 60%. The results are consistent with the embedded-atom-method prediction ofsubstantial subsurface H and with previous electron-stimulated desorptionmeasurements.

33927 Resistance noise in amorphous Ni-Zr: Hydrogen diffusion and universal conductance fluctuations. Alers, G. B. (Department of Physics, University of Illinois at Urbana-Champaign, 1110 West Green Street, Urbana, Illinois 61801(US)); Weissman, M. B.; Averback, R. S.; Shyu, H. *Physical Review [Section] B: Condensed Matter (USA),* 40(2): 900-906 (15 Jul 1989).

Resistance fluctuations with a power spectrum of approximately$1/f$ have been studied in amorphous thin films of$Ni_{30}Zr_{70}$ and$Ni_{50}Zr_{50}$ in the temperature range$4 < T < 350$ K. The primary noise-generating source was found tobe hydrogen contamination with concentrations up to roughly 30 at. %.Exceptionally large peaks in the spectral density versus T correspondingto short-range hopping of hydrogen atoms were found between 90 and 200 K. Therms resistivity change due to short-range hopping of a hydrogen atom was foundto be larger than the average resistivity increase per atom, indicating theimportance of the random local environment. Below 50 K the noise increased withdecreasing temperature and was reduced by magnetic fields, indicating auniversal conductance-fluctuation-coupling mechanism.

33928 Cluster interactions and physical properties of Al–transition-metal alloys. Carlsson, A. E. (Department of Physics, Washington University, St. Louis, Missouri 63130(US)). *Physical Review [Section] B: Condensed Matter (USA),* 40(2): 912-923 (15 Jul 1989).

Ising-like interaction parameters are calculated for alloys of Al with the3d and 4d transition metals. The interactions are obtained bymatching to calculated total energies for supercell compounds on an underlyingfcc lattice. The dependence of the parameters on the transition-metal$d$-band filling displays pronounced oscillations, which are interpreted interms of the width and shape of the electronic density of states. Theinteractions are used to provide the first unified *ab initio* descriptionof a wide variety of phenomena in these alloys. Results for heats of solidsolution in transition-metal-rich alloys are in good agreement withexperimental values for fcc and hcp phases.

Observed chemical trends in solidsolubilities, including the values in Al-Mn, are confirmed and explained.Effective pair interactions for describing short-range order are in fairly goodagreement with empirical values obtained from short-range-order data and otherobservations.

33929 Crystal-melt and melt-vapor interfaces of nickel. Chen, E. T. (School of Physics, Georgia Institute of Technology, Atlanta, Georgia 30332-0430(US)); Barnett, R. N.; Landman, U. *Physical Review [Section] B: Condensed Matter (USA),* 40(2): 924-932 (15 Jul 1989).

The equilibrium crystal-to-melt interfaces for Ni(001) and Ni(111) and themelt-to-vapor interface are investigated at the melting point, with use ofmolecular-dynamics simulations and the embedded-atom method. The meltingtemperature of nickel determined from these simulations is1733±22 K, in good agreement with the experimental value.The crystal-to-melt interface is found to be characterized by liquid layering,with properties such as structural order parameters and diffusion coefficientsvarying gradually across the transition region. The transition region extendsover several layers and is more diffuse at the (001) interface. At themelt-to-vapor interface the density increases, driven by an increase in themagnitude of the density-dependent embedding-energy contribution to thecohesive energy of the metal. This behavior is in contrast to that found at themelt-to-vapor interface of nonmetallic systems.

33930 Magnetic ordering of thin Gd overlayers. LaGraffe, D. (Department of Physics, Syracuse University, Syracuse, New York 13244-1130(US)); Dowben, P. A.; Onellion, M. *Physical Review [Section] B: Condensed Matter (USA),* 40(2): 970-976 (15 Jul 1989).

1–6-monolayer-thick films of Gd have been studied with use ofsynchrotron-radiation photoemission. A method is described that utilizes thelinear light polarization to obtain information about the overlayermagnetization. The method is complementary to electron-spin-polarizationtechniques. The thinner Gd overlayers exhibit a local magnetization componentalong the surface normal that decreases for thicker overlayers. The Gd filmsexhibit a 5*d* exchange splitting that changes from approximately 1.1 to0.6 eV as the overlayer thickness increases.

33931 Simplified pseudopotential expansion theory for Al-Li alloys. Lu, D. (Department of Physics, Washington University, St. Louis, Missouri 63130(US)); Carlsson, A. E. *Physical Review [Section] B: Condensed Matter (USA),* 40(2): 980-987 (15 Jul 1989).

A new pseudopotential expansion theory is developed fornearly-free-electron alloys. This theory includes local-density-dependentcorrections to the usual pair potentials, to take into account long-wavelengthcharge-density fluctuations. A simplified treatment of the nonlocality of thepseudopotential is presented as well. Using this theory, the heat of formationand lattice constant are calculated for several ordered and disordered phasesof Al-Li alloys. The importance of the local-density correction and thenonlocal pseudopotential terms to the atomic bonding in these alloys isanalyzed, and the results are compared with experiments. The dominantexothermic contribution to the heat of formation comes from the nonlocality ofthe Li pseudopotential. Inclusion of the local-density and nonlocalpseudopotential terms results in considerably improved heats of formation. Theconcentration dependence of the calculated heats of formation and orderingenergy is consistent with experiment and more accurate density-functionalband-structure calculations. The results for the lattice constants of theordered compounds agree well with experiment, and the experimentally observedlattice contractions of the solid solutions are also found. However, thefailure of our method in constructing an accurate phase diagram from thecalculated heats of formation indicates that further improvements, includinghigher-order terms in the strong Al pseudopotential, are needed.

33932 Trapping of deuterium by helium bubbles and defects in ion-implanted tantalum. Lee, S. R. (Sandia National Laboratories, Albuquerque, New Mexico 87185-5800(US)); Myers, S. M.; Spulak, R. G., Jr. *Journal of Applied Physics (USA),* 66(3): 1137-1148 (1 Aug 1989). DOE Contract AC04-76DP00789.

Nuclear reaction analysis and ion implantation techniques were used to investigate the trapping of deuterium (D) by He bubbles and implantation defects in Ta. A series of four complementary temperature ramp experiments have enabled us to determine that: (1) the binding enthalpy of D at trap sites associated with He bubbles in Ta is 0.53±0.05 eV relative to solution sites; (2) the binding enthalpies of D at implantation defects in Ta are 0.53±0.10, 0.42±0.10, and 0.33±0.10 eV; and (3) the approximate number of He bubble trap sites produced per He atom implanted into Ta is 0.45 for mean He atomic fractions ranging from 1.5% to 2.5%. The measured binding enthalpies are compared with effective-medium theory calculations of the binding enthalpies of both hydrogen chemisorption sites and monovacancy sites containing from one to six trapped hydrogen atoms. This comparison suggests that the strongest 0.53-eV traps associated with implanted He are bubbles which trap hydrogen on their interior surface via a chemisorptionlike mechanism. The strong 0.53-eV defect trap sites are probably vacancy clusters, whereas the 0.42-eV defect traps appear to be monovacancy sites containing one to two hydrogen atoms, and the 0.33-eV sites appear to be monovacancy sites containing three to six hydrogen atoms.

33933 Interfacial decohesion around spheroidal carbide particles. Kwon, D. (Max-Planck-Institut fur Metallforschung, Institut fur Werkstoffwissenschaften, Seestrasse 92, D-7000 Stuttgart 1 (DE)). *Scripta Metallurgica (USA),* 22(7): 1161-1164 (Jul 1988).

The 1518 steel used in this study was austenitized at 1000^{0}C for 1.5h, quenched in ice water, aged at 690^{0}C for six days and air cooled. Interfacial stress on the order of 1200 MPa (μ/35) was estimated by use of a dislocation model and is comparable with the values of 1000 - 2000 MPa in the literature for spheroidized steels with carbide diameters ranging between 0.2 and 1.0 μm. The similarity of the values for the smooth tensile case (1205 MPa) and the notched tensile case (1230 MPa) supports the assumption on which the critical stress criterion is based, namely that void nucleation occurs when the local interfacial stress at a particle reaches a critical interfacial strength, which is a material characteristic.

33934 Structure, properties and fracture of pulsed Nd:YAG laser welded Ti-14.8wt%Al-21.3wt%Nb titanium aluminide. Baeslack, W.A. (The Ohio State Univ., Columbus, OH (US)); Cieslak, M.J.; Headley, T.J. *Scripta Metallurgica (USA),* 22(7): 1155-1160 (Jul 1988).

Recent rapid solidification, powder metallurgy and quenching studies on Nb-rich Ti-Al-Nb alloys have determined that rapid cooling suppresses beta decomposition to α_2 and instead promotes the formation of an ordered BCC β superlattice (CsCl) designated as B2. Based on these observations, the present study was initiated in which a pulsed Nd:YAG laser was utilized to generate a rapidly cooled fusion zone microstructure in Ti-14-21 comprised of a potentially ductile ordered β phase. The authors have determined that the generation of a metastable ordered β-phase can improve weld ductility while providing hardness levels superior to that of the base metal. Although laser processing should alleviate weld cracking, the optimization of weld properties in service will require the determination of an optimum stabilizing heat treatment which provides acceptible room and elevated temperature properties.

33935 High resolution detection of solute segregation to the cores of dislocations in grain boundaries. Michael, J.R. (Homer Research Lab., Bethlehem Steel Corp., Bethlehem, PA (US)); Lin, C.H.; Sass, S.L. *Scripta Metallurgica (USA),* 22(7): 1121-1124 (Jul 1988).

The segregation of solute atoms to grain boundaries in polycrystalline solids can be responsible for embrittlement of the boundaries. Auger electron spectroscopy and analytical electron microscopy [AEM] have verified the occurrence of solute segregation to grain boundaries, however, there has been little experimental evidence concerning the distribution of the solute within the plane of the interface. Au segregation causes a change in the primary dislocation structure of small angle [001] twist boundaries in Fe. [001] twist boundaries have been produced in bicrystals of both pure Fe, and Fe containing a small amount of Au. The boundary structure characteristic of pure Fe, which is square <110> dislocation network, changes to two different square dislocation networks, <110> and <100>-type, when 0.17 at% Au is added to the bicrystal and Au segregates to the boundary at its midplane. Rutherford backscattering spectroscopy was used to demonstrate that there

was Au segregation to the interface, and analytical electron microscopy showed that the <100> network was Au-rich relative to the <110> network. The present study has clearly established that Au segregates extensively to the a<100> dislocation cores, it remains to understand why the presence of Au has a stronger influence on the core structure and energy of the a<100> rather than the a/2<111> dislocation, leading to the stabilization of the a<100> dislocation network. Theoretical calculations are needed to examine the influence of solute segregation on the core energy of dislocations in Fe and Fe alloys. Work is in progress to obtain quantitative information on the amount of Au at the cores.

33936 Band folding and energy-gap formation in Ag-Au superlattices. Miller, T. (Department of Physics, University of Illinois at Urbana-Champaign, 1110 West Green Street, Urbana, Illinois 61801(US)); Mueller, M.; Chiang, T. *Physical Review [Section] B: Condensed Matter (USA),* 40(2): 1301-1304 (15 Jul 1989). DOE Contract AC02-76ER01198.

The electronic band structures of superlattices consisting of alternating(111) slabs of Ag and Au were investigated with use of angle-resolved photoemission. The fundamental electronic effects of a superlattice potential,including band folding and the formation of energy gaps at the new zone boundaries, were clearly observed.

33937 Direct observation of the compositional disordering of Ni_3Al in the vicinity of grain boundaries using high resolution electron microscopy techniques. Mackenzie, R.A.D. (Dept. of Materials Science and Engineering, Cornell Univ., Ithaca, NY (US)); Sass, S.L. *Scripta Metallurgica (USA),* 22(11): 1807-1812 (Nov 1988).

The ordered compound Ni_3Al is potentially useful as a high temperature structural material, since its yield stress increases with increasing temperature up to $\sim 650^0$. The major obstacle to the structural use of polycrystalline Ni_3Al is its tendency to fail intergranularly. The ductility of Ni_3Al can be improved by the addition of small amounts of boron to a slightly Ni-rich compound. The boron is found to segregate to the grain boundaries, and changes the fracture mode from intergranular to transgranular by a mechanism which is not yet understood. Possible explanations for the presence of a/2<110>-type dislocations are: (i) the dislocations are imperfect, with the associated antiphase boundary contrast not visible, or (ii) the Ni_3Al is disordered in the vicinity of the interface, resulting in a thin layer of f.c.c. material at the boundary, and the dislocations then have the expected f.c.c. Burgers vector. In support of the possibility of disordering are atom-probe field ion microscopy observations which showed that the boundary region is Ni-rich, with deviations from the average alloy composition of up to 5 at % Ni. It is reasonable to predict that the thickness of the disordered layer will be a function of temperature, and so the contribution of the disordered layer to the mechanical properties may also be temperature dependent. It can be speculated that the solubility of boron, and any other impurities that are present, will be different in disordered and ordered Ni_3Al.

33938 Electron-electron interactions and the bandwidth of metals. Mahan, G. D. (Department of Physics and Astronomy, University of Tennessee, Knoxville, Tennessee 37996-1200(US)); Sernelius, B. E. *Physical Review Letters (USA),* 62(23): 2718-2720 (5 Jun 1989). DOE Contract AC05-84OR21400.

A calculation is presented of the self-energy of an electron from the screened exchange energy. Vertex corrections are included. They have a large effect upon the predictions of the width of the occupied energy bands. For aluminum the band-width is predicted to be 0.7 eV wider in the *GW*approximation compared to *GW*Γ which includes vertex corrections. Results using the *GW*Γ approximation are similar to those of the random-phase approximation.

33939 Studies of individual nanometer-sized metallic clusters using scanning tunneling microscopy, field emission, and field ion microscopy. Castro, T. (Department of Physics, Purdue University, W. Lafayette, Indiana 47907(US)); Li, Y. Z.; Reifenberger, R.; Choi, E.; Park, S. B.; Andres, R. P. *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films (USA),* 7(4): 2845-2849 (Jul 1989).

Individual clusters of gold, grown in a gas aggregation reactor and deposited on a variety of different substrates, have been studied using a combination of scanning tunneling microscopy, field emission techniques, and field ion microscopy. The scanning tunneling microscope studies show that by proper choice of substrate, individual nanometer-sized clusters can be reproducibly imaged and studied. The field emission and field ion microscope studies yield information about the work function and melting temperature of individual supported clusters.

33940 Scanning tunneling microscopy of the intergrowth tungsten bronze $Rb_{0.05}WO_3$. Norton, M. L. (Department of Chemistry, School of Chemical Sciences, University of Georgia, Athens, Georgia 30602(US)); Mantovani, J. G.; Warmack, R. J. *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films (USA),* 7(4): 2898-2900 (Jul 1989). DOE Contract AC05-84OR21400.

The surface structure of the intergrowth tungsten bronze, $Rb_{0.05}WO_3$ was imaged at nanometer scale resolution using a scanning tunneling microscope in air. The images are explained within the context of the crystallographic properties of the material.

33941 Interfacial bonding in W/C and W/B_4C multilayers. Jankowski, A. F. (Lawrence Livermore National Laboratory Chemistry & Materials Science, Livermore, California 94550(US)); Schrawyer, L. R.; Wall, M. A.; Craig, W. W.; Morales, R. I.; Makowiecki, D. M. *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films (USA),* 7(4): 2914-2918 (Jul 1989). DOE Contract W-7405-ENG-48.

The nature of carbon bonding in W/C and W/B_4C multilayer structures is investigated by Auger electron spectroscopy (AES). The interfacial roughness in these x-ray mirrors directly affects their use as efficient optical elements. A significant contribution to interfacial roughness is the possible presence of second phases, WC in particular for the W/C and W/B_4C combinations. AES depth profiling of the multilayer interfaces is used as a direct method to probe for the existence of WC.

33942 Effect of high-energy ion irradiation on the elastic moduli of Ag/Co superlattices. Hues, S. M. (Chemistry Division, Naval Research Laboratory, Washington, D.C. 20375-5000(US)); Bhadra, R.; Grimsditch, M.; Fullerton, E.; Schuller, I. K. *Physical Review [Section] B: Condensed Matter (USA),* 39(17): 12966-12968 (15 Jun 1989). DOE Contract W-31-109-ENG-38.

The elastic moduli of Ag/Co superlattice structures have been studied byBrillouin scattering, as a function of irradiation with 6-MeV C^+ions. A hardening of the superlattice structures with increasing dose wasobserved. These results imply that the elastic-constant anomalies in metallicsuperlattices are due to the strains present. The origin of the strains,however, cannot be uniquely identified.

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Refer also to citation(s) 33040, 33201, 33285, 33399, 33443, 33444, 33612, 33815, 33820, 33823, 33825, 33828, 33832, 33835, 33836, 33837, 33838, 33841, 33908, 33916, 34094, 35213, 35246

33943 (AECL–8642) Oxidation of UO_2 at 400 to 1000 degrees C in air and its relevance to fission product release. McCracken, D.R. Atomic Energy of Canada Ltd., Chalk River, ON (Canada). Chalk River Nuclear Labs. Jul 1985. 85p. Order Number DE89619566/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

Currently there is great interest in the behaviour of UO_2 under oxidizing conditions because irradiated uranium dioxide fuel can conceivably be exposed to a hot oxidizing atmosphere as a result of accidents. The temperature range covered in this paper is 400 to 1000 degrees C. At these high temperatures, UO_2 in air can oxidize rapidly to U_3O_8 via U_3O_7 and/or U_4O_9. The accompanying volume increase and corresponding stresses lead to fragmentation of the fuel pellets. The purpose of this work was to investigate the dependence of UO_2 oxidation on temperature, rate of air supply and residence time at temperature; to determine the rate controlling steps and rate of oxygen penetration; and to characterize the oxidation products and size of fragments. In addition, detailed metallography was related to X-ray diffraction studies of the oxidized

UO_2 to facilitate future study of irradiated fuel, which is easier to do by metallography in hot-cells than by X-ray diffraction. Samples were heated in argon, then once at temperature they were exposed to air at a controlled flow-rate. Studies of the oxidation of unirradiated UO_2 pellets in air show two distinct types of oxidation with a change in mechanism at 600-700 degrees C. At temperatures $\leq$ 600 degrees C fragmentation accompanies the formation of U_3O_8 while at T $\geq$ 800 degrees C, rapid grain growth occurs. In the first temperature region, volatile fission product releases are small, while in the second region, 100% release can be correlated with U_3O_8 formation. In the first region, only the grain boundary inventory is released while in the other, 100% of the Xe, Kr, Ru, Sb, Cs and I are released. (Abstract Truncated)

33944 (CEA-CONF–9766) **Study of non stoichiometric pure and Zr-Doped yttria surfaces by X-Ray photoelectron spectroscopy and scanning electron microscopy.** Gautier, M.; Duraud, J.P.; Jollet, F.; Thromat, N.; Maire, P.; Le Gressus, C. CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physico-Chimie. 1988. 13p. (CONF-8809361–: Surface and interface of ceramics materials summer school, Oleron, France, 4-16 Sep 1988). Order Number DE89781581/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Surfaces of oxygen-deficient yttrium oxide, pure or Zr-doped, have been studied by means of X-ray photoelectron spectroscopy and scanning electron microscopy. The bulk local geometric structure of these non-stoichiometric compounds was previously determined around the Y atom by an EXAFS (Extended X-ray absorption fine structure) study. The local electronic structure around both Y and O, at the surface, was investigated by X-ray photoelectron spectroscopy. The partial transfer of the electronic distribution between the anion and the cation was probed using the Auger parameter. Coupling of these experiments with microscopic observations show that: - In the pure oxygen-deficient sample, the concentration of oxygen vacancies appears to be increased at the grain boundaries. - The Auger parameter shows upon reduction an evolution of the Y-O bond towards a more covalent one, this evolution being modulated with the presence of $Zr0_2$.

33945 (CONF-890216–2) **Recent improvements in bulk properties of ceramic superconductors.** Poeppel, R.B.; Balachandran, U.; Bloom, I.; Dorris, S.E.; Dusek, J.T.; Goretta, K.C.; Lanagan, M.T.; Leu, H.J.; Maroni, V.A.; Picciola, J.J. Argonne National Lab., IL (USA). Jan 1989. 14p. Sponsored by DOE Energy Research. DOE Contract W-31109-ENG-38. From International symposium on high $T_c$superconducting oxides: processing and related properties; Las Vegas, Nevada, USA; 27-28 Feb 1989. Order Number DE89013626/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Ceramic superconductors are being considered for uses ranging from large-scale applications such as the generation, transmission, and storage of electricity to small-scale applications such as electronic circuitry. These applications require that the electrical, mechanical, and chemical properties of superconductors meet certain specifications. The properties of superconductors are strongly influenced by each step of the processing procedure, which includes powder processing to form the superconductor powder, shape forming to produce bulk superconductors in convenient shapes, and finally an appropriate heat treatment to yield good superconducting properties. In this paper, the processing procedures for Y-Ba-Cu-O, Bi-Sr-Ca-Cu-O, Tl-Ca-Ba-Cu-O will be reviewed. Improvements in the processing procedures, and the resulting improvements in the mechanical and electrical properties, will be discussed. In addition, several fabrication techniques will be described which have produced bulk conductors having critical current densities approaching those of thin films. 28 refs., 5 figs.

33946 (CONF-890653–1) **Fractographic study of a silicon nitride ceramic.** Ferber, M.K.; Tennery, V.J. Oak Ridge National Lab., TN (USA). 1989. 9p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. From First European Ceramic Society conference (ECerS-1); Maastricht, Netherlands; 19-23 Jun 1989. Order Number DE89013012/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A commercially available Si_3N_4 ceramic was fractured in four-point flexure at room temperature as part of a round robin study involving 13 laboratories in the United States, Federal Republic of Germany, and Sweden. A minimum of 60 samples were fractured by each participant. For each specimen set tested, approximately 15 samples representing the five highest strength bars, the five lowest strength bars, and five bars nearest the mean of the strength distribution were chosen for fractographic examination. The nature, location, and size of the defects responsible for failure were determined. The resulting information was used to examine the applicability of strength-flaw size relationships. 6 refs., 4 figs.

33947 (CONF-890720–1) **Comparison of the magnetic properties of iron and manganese ion implanted silica.** Whichard G.; Weeks, R.A.; Zuhr, R.A. Oak Ridge National Lab., TN (USA). 1989. 7p. Sponsored by DOE Energy Research. DOE Contract AC05-84OR21400. From 15. international congress on glass; Leningrad, SU; July 2, 1989. Order Number DE89002214/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The surface regions of high purity silica discs were modified by the implantation of Mn^+ and Fe^+ ions. The electron paramagnetic resonance spectra of the Mn implanted samples show the resonance field of the most intense spectral component to be variant with temperature between 300 and 80 K, and independent of the orientation of the implanted surface with respect to the laboratory magnetic field. In the Fe implanted samples, orientation effects, indicating long range magnetic order, and a shift in the resonance field, with temperature illustrate that the magnetic properties of Fe and Mn ion implanted silica differ significantly. 10 refs., 3 figs.

33948 (CONF-8810117–2) **The role of x-ray absorption spectroscopy in electronic structure studies.** Alp, E.E. Argonne National Lab., IL (USA). May 1989. 12p. Sponsored by DOE Energy Research. DOE Contract W-31109-ENG-38. From Workshop on applications of synchrotron radiation in chemical research; Argonne, Illinois, USA; 3-4 Oct 1988. Order Number DE89014677/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The usefulness of x-ray absorption spectroscopy in studies of electronic structure in materials is discussed. 7 refs., 4 figs. (CBS)

33949 (DOE/ER/01198–T14, pp. 93-105) **Chemistry of new transition metal ceramic compounds synthesized by MOCVD.** Girolami, G.S. Illinois Univ., Urbana, IL (USA). Materials Research Lab. Mar 1988. In *Materials Research Laboratory: Renewal proposal for the extension in time and funds.* Order Number DE88013776/JAW. Available from NTIS, PC A99/MF A01; 1.

The purpose of this program is to develop new chemical vapor deposition procedures for the preparation of thin films of ceramic and electronic materials at unprecedentedly low temperatures through the use of tailored organometallic precursors. While conventional CVD methods for the synthesis of thin films of materials such as titanium carbide require temperatures in excess of 1000°C, the authors have developed methodology for the preparation of such films at 150°C. Research is progressing in three areas. First, organometallic compounds such as $M(CH_2CMe_3)_4$ and related species are being prepared to serve as low temperature CVD precursors for the metal carbides ZrC, HfC, NbC, TaC, MoC, and WC; this work is based on their successful results in the TiC system. Second, metal nitrides, silicides, and borides are being approached either via one component precursors such as the tetrahydroborates $Zr(BH_4)_4$ and $Hf(BH_4)_4$, or by a two component method involving co-deposition of a transition metal alkyl such as $Ti(CH_2CMe_3)_4$ and a main group hydride such as SiH_4 or NH_3. For example, TiB_2, ZrB_2 thin films can be prepared at 250°C by using this approach, compared with the 1200°C temperatures characteristic of conventional CVD methods. Third, the CVD preparation of thin films of metals and alloys at low temperatures are being investigated using precursors such as the π-allyl complex $Pd(C_3H_5)_2$, which gives high-quality Pd thin films at 250°C. Fourth, metal oxides and sulfides, including the recent $MBa_2Cu_3O_7$ high-T_c superconducting materials, are being targeted as potential MOCVD products from organometallic precursors. Investigations of the physical and mechanical properties will be carried out with a view toward determining the characteristics of films constructed atom by atom under conditions where metastable pha

33950 (DOE/ER/01198–T14, pp. 143-158) **Processing and microstructure of complex ceramic systems.** Zangvil, A. Illinois

Univ., Urbana, IL (USA). Materials Research Lab. Mar 1988. In *Materials Research Laboratory: Renewal proposal for the extension in time and funds.* Order Number DE88013776/JAW. Available from NTIS, PC A99/MF A01; 1.

This research program is aimed at acquiring a basic understanding of the dependence of microstructure, microchemistry and resultant properties on processing conditions, in relatively complex ceramic materials for advanced energy-related applications. Efforts are directed toward multi-phase ceramic aggregates, ceramic solid solutions, and ceramic-ceramic composites. These studies are directed towards (1) clarifying the effects of coexistence of several components or phases, (2) devising ways to improve processing conditions and control of the microstructure and properties, and (3) developing novel ceramic systems with potentially superior properties. High resolution microstructural and microchemical investigations will focus on clarifying grain boundary and phase boundary phenomena, interdiffusion, phase stability/relationships, and microstructural stability. The dependence of grain and phase boundary properties on composition and processing conditions (sintering, hot-pressing, hot-isostatic-pressing) will be studied. The program is focusing its efforts on the SiC-AlN, SiC-BN and SiC-BeO systems; transition metal compounds as additives to SiC; toughening in SiC materials; and on mullite matrix-SiC whisker - ZrO_2 composites.

33951 (DOE/ER/01198–T14, pp. 201-216) **High temperature toughening mechanisms in composite ceramics.** Kriven, W.M. Illinois Univ., Urbana, IL (USA). Materials Research Lab. Mar 1988. In *Materials Research Laboratory: Renewal proposal for the extension in time and funds.* Order Number DE88013776/JAW. Available from NTIS, PC A99/MF A01; 1.

The aim of this project is to design and develop new types of ceramic-ceramic composite materials for structural applications at elevated (> 1000°C) and ambient temperatures. The materials have enhanced mechanical properties such as reduced brittleness, increased strength and modified creep behavior. Two mechanisms for achieving this are investigated: (i) the application of stress-induced, martensitic transformations in non-metals and (ii) whisker-reinforcement of ceramics. Several potential transformation tougheners alternative to zirconia (ZrO_2) have been identified. In particular, the lanthanide sesquioxides (Ln_2O_3) having an M_S {<=} 1950°C have the potential for high temperature transformation toughening. They have significantly increased volume changes (+8%), as compared to ZrO_2 (+5%) and so are expected to be even more powerful tougheners than ZrO_2. Processing procedures for dispersing these materials into chemically compatible (i.e. unreactive) matrices have been developed. The mechanical properties of 20 vol% Tb_2O_3 in 80 vol% MgO have been measured by 3-point bending and Vickers indentation techniques up to temperatures of 1400°C. Transformation toughening beings at 1100°C with the formation of a transformation zone around a propagating crack. At 1300°C spontaneous thermally induced transformation occurs on the surfaces of dense bodies thereby increasing their strength through additional surface compressive stresses. At 1400°C bulk transformation occurs giving a three-fold increase in toughness. Micromechanical observations by TEM, HVEM and SEM techniques are being correlated with macromechanical properties. For high temperature applications ceramic matrices reinforced with alumina and mullite whiskers are being fabricated and mechanically evaluated. The chemical stability up to > 1500°C provide significant improvements over the current use of silicon

33952 (DOE/ER/01198–T14, pp. 283-292) **Molecular building-block approaches to ceramic materials.** Klemperer, W.G. Illinois Univ., Urbana, IL (USA). Materials Research Lab. Mar 1988. In *Materials Research Laboratory: Renewal proposal for the extension in time and funds.* Order Number DE88013776/JAW. Available from NTIS, PC A99/MF A01; 1.

A molecular building-block approach to the synthesis of ceramic materials is being developed along the lines previously established by organic chemists for the synthesis of polymers. At present, attention is focused on the controlled synthesis of oxide materials through the construction of complex molecular oxide precursor molecules and their polymerization using sol-gel hydrolysis/condensation techniques. Considerable process has been achieved in the synthesis of molecular building block precursors for silica, such as the cubic $[Si_8O_{12}](OCH_3)_8$ molecule. An intensive mechanistic study of silica sol-gel polymerization is in progress that has for the first time delineated the molecular growth pathways operative. With this knowledge in hand, optimum conditions for polymerizing complex silicates are being developed. The first steps are being taken to extend this approach to the synthesis of transition metal oxides using metal trimethylsiloxides.

33953 (DOE/ER/01198–T14, pp. 293-306) **Synthesis and properties of dielectric solids.** Payne, D.A. Illinois Univ., Urbana, IL (USA). Materials Research Lab. Mar 1988. In *Materials Research Laboratory: Renewal proposal for the extension in time and funds.* Order Number DE88013776/JAW. Available from NTIS, PC A99/MF A01; 1.

The electrical ceramics research program is concerned with the chemical synthesis, crystal growth, ceramic processing, microstructure development, characterization and property measurements on new and improved ceramic materials for energy related applications. Previous work was concerned with perovskite (e.g., $PbTiO_3$) and layered structure compounds (e.g., $Bi_4Ti_3O_{12}$). Recent work has been directed at high T_c ceramic superconductors with related structures. A central theme of the project has been the interrelationships that exist between processing, structure development and properties for electrical ceramics. Novel methods of preparation include (i) chemical preparation by the Pechini route, (ii) sol-gel processing with polymeric alkoxides, and (iii) rapid solidification of amorphous precursors. The overall purpose is to obtain a more fundamental understanding of the relationships between microstructure and properties, and to develop novel methods for materials preparation and processing. With respect to ceramic superconductors, the Pechini method was used to prepare stable homogeneous solutions from which fine powders were obtained. Dense ceramic microstructures were formed by hot-pressing methods. The extent of diamagnetic flux exclusion was found to increase with oxygen annealing conditions. Results were in agreement with a proposed shell model with percolation of the resistive transition behavior.

33954 (DOE/ER/01198–T14, pp. 331-349) **Processing of monodisperse ceramic powders.** Zukoski, C.F. Illinois Univ., Urbana, IL (USA). Materials Research Lab. Mar 1988. In *Materials Research Laboratory: Renewal proposal for the extension in time and funds.* Order Number DE88013776/JAW. Available from NTIS, PC A99/MF A01; 1.

This program is aimed at developing a basic understanding of the factors which influence the formation of low flaw density advanced ceramics. Primarily the physical chemistry which controls the morphology, size distribution, and crystallinity of ceramic precursor powders prepared through solution precipitation techniques is under investigation. Their goal is to develop quantitative models of processes to be used in the preparation of particles where morphological control is currently difficult, and in the scale up of these precipitations. Secondly, particle interactions in concentrated suspensions, their influence on the solid's spatials distribution in highly loaded suspensions and the development of defects in green bodies are being explored. Their goal is to develop methods of preparing green bodies with reproducible microstructures of desirable properties. The transport and particle orientation properties of suspensions containing mixtures of rod and sphere-like particles will be explored. The third stage of this project is to combine the knowledge gained on the preparation of model particles and their flow and ordering properties to investigate the influence of powder processing variables on the final properties of the sintered ceramic. The authors are investigating the effects of particle size distribution and packing order on sinterability of powder compacts and the solid's final microstructure.

33955 (INIS-BR–1483, pp. 9) **Thin films of indium oxide doped with tin by reactive co-evaporation.** Sassaki, C.A.; Pereyra, I.; Andrade, A.M. de. Minas Gerais Univ., Belo Horizonte (Brazil). Dept. de Fisica. 1989. (In Portuguese). (CONF-8901126–: 4. Brazilian school of semiconductor physics, Belo Horizonte, Brazil, 23 Jan - 3 feb 1989). In *Proceedings of the 4. Brazilian School of Semiconductor Physics.* Order Number DE89612194/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

INDIUM OXIDES/crystal doping; INDIUM OXIDES/thin films; THIN FILMS/electrical properties; TIN/crystal doping; CRYSTAL STRUCTURE; EVAPORATION; OPTICAL PROPERTIES; QUANTITY RATIO; TIN; X-RAY DIFFRACTION

33956 (INIS-SU–80, pp. 42-43) **Radiation mechanism of in-grain bubble production in uranium dioxide.** Lemekhov, S.E. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Atomnoj Ehnergii). Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. (In Russian). In *Physics of radiation defects and radiation materiss science. Scientific-technical collection.* Order Number DE89012114/JAW. Available from NTIS (US Sales Only), PC A05/MF A01; INIS.

Voprosy atomnoj nauki i tekhniki.; no. 3(41).

Mechanism of in-grain bubble production (IGB) in tracks of uranium dioxide fission fragments, caused by stabilization of gaseous fission products (GFP) of nonequilibrium vacancy clusters, forming along the axis of fission fragment track, is considered. In the suggested approach the number of stabilized track clusters (IGB products) is not a free parameter, but is defined by the local values of radiation temperature and GFP in-grain concentration. 11 refs.; 1 tab.

33957 (LBL–26850) **Improved industrial catalysts: Part 1, Catalysts for NO and NOsub x removal: Final report.** Heinemann, H.; Somorjai, G.A.; de la Banda, J.G. Lawrence Berkeley Lab., CA (USA). Feb 1989. 89p. Sponsored by DOE Management & Administration. DOE Contract AC03-76SF00098. Order Number DE89012833/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

A careful investigation with many tools has been undertaken of the reaction of NO_x and ammonia over vanadia-titania catalysts in the presence of oxygen. An understanding of a novel mechanism has been achieved which indicates that the catalytic reaction is essentially a redox reaction of 5 valent and 4 valent vanadia. In an attempt to produce improved catalysts, it has been proposed to use pelleted catalysts instead of the honeycomb catalysts currently being used commercially. This would save a great deal of expense in catalyst manufacture, but requires that the pelleted catalysts be hard enough to withstand abrasion at very high gaseous space velocities. It has been found that extrusion of titania containing vanadia in the presence of some phosphoric acid as a binder gives sufficiently hard catalysts which, however, show a loss of activity of about 10%. This loss of activity has been traced to the formation of surface vanadium phosfates and titanium phosfates. Life tests have shown that while loss of activity prevails over long periods of time, the activity curve for the non-phosphorous containing and the phosphorous containing catalysts are parallel. It has also been shown that by reducing the space velocity by about a factor of 2, activities of the phosphorous containing catalysts match that of the non-phosphorous containing catalysts. This means that the catalyst volume will have to be about double, which probably still presents an advantage over the expensive honeycomb catalyst. 19 refs., 33 figs., 20 tabs.

33958 (PB–89-148381/XAB) **Institute for Materials Science and Engineering, Ceramics: technical activities, 1988.** Hsu, S.M. National Inst. of Standards and Technology (IMSE), Gaithersburg, MD (USA). Ceramics Div. Feb 1988. 92p. (NISTIR–88/3840). Available from NTIS, PC A05/MF A01.

See also PB–86-196771.

Current programs of the Ceramics Division are reviewed. Programs include: grain-boundary chemistry and structure of YBaCuO superconductors; compilation of phase diagrams for salt systems; diamond-film synthesis; tribology; composites; wear maps; tensile tests; time-resolved micro RAMAN analysis; typographic imaging (synchrotron radiation analysis).

33959 (PB–89-855969/XAB) **Silicon nitride ceramics and refractories. February 1987-January 1988 (Citations from the COMPENDEX data base). Report for February 1987-January 1988.** National Technical Information Service, Springfield, VA (USA). Feb 1989. 109p. Available from NTISPC N01/MF N01.

See also PB–89-855977.

This bibliography contains citations concerning developments and applications of silicon nitride materials. Topics include mechanical and thermal properties, structural analyses, preparation techniques, and the effects of composition on specific material properties. Applications in cutting tools and aluminum silicon oxynitride (SIALON) technology are presented. (This updated bibliography contains 240 citations, none of which are new entries to the previous edition.)

33960 (PB–89-855977/XAB) **Silicon nitride ceramics and refractories. February 1988-February 1989 (Citations from the COMPENDEX data base). Report for February 1988-February 1989.** National Technical Information Service, Springfield, VA (USA). Feb 1989. 114p. Available from NTISPC N01/MF N01.

Supersedes PB–88-857354. See also PB–89-855969.

This bibliography contains citations concerning developments and applications of silicon nitride materials. Topics include mechanical and thermal properties, structural analyses, preparation techniques, and the effects of composition on specific material properties. Applications in cutting tools and aluminum silicon oxynitride (SIALON) technology are presented. (This updated bibliography contains 206 citations, all of which are new entries to the previous edition.)

33961 (PB–89-856215/XAB) **Optical coatings. January 1983-October 1987 (Citations from the COMPENDEX data base). Report for January 1983-October 1987.** National Technical Information Service, Springfield, VA (USA). Feb 1989. 165p. Available from NTISPC N01/MF N01.

See also PB–89-856223.

This bibliography contains citations concerning the technology of mirror or lens coatings with a film of proper thickness and refractive index to reduce reflective qualities. The use of selective coatings in solar-energy collectors; optical, infrared, and x-ray instruments; and, electroconductive and dielectric coatings for lasers and solar cells, are examined. Methods of applications, as well as performance evaluations, are included. (This updated bibliography contains 387 citations, none of which are new entries to the previous edition.)

33962 (PB–89-856223/XAB) **Optical coatings. November 1987-February 1989 (Citations from the COMPENDEX data base). Report for November 1987-February 1989.** National Technical Information Service, Springfield, VA (USA). Feb 1989. 33p. Available from NTISPC N01/MF N01.

Supersedes PB–88-850037. See also PB–89-856215.

This bibliography contains citations concerning the technology of mirror or lens coatings with a film of proper thickness and refractive index to reduce reflective qualities. The use of selective coatings in solar-energy collectors; optical, infrared, and x-ray instruments; and, electroconductive and dielectric coatings for lasers and solar cells, are examined. Methods of applications, as well as performance evaluations, are included. (This updated bibliography contains 46 citations, all of which are new entries to the previous edition.)

33963 (SAND–89-1300C) **Thin film preparation and single film device fabrication in the Tl-Ca-Ba-Cu-O HTS system.** Ginley, D.S.; Kwak, J.F.; Venturini, E.L.; Morosin, B.; Baughman, R.J.; Martins, J.S.; Nordman, J.E.; Beyer, J.B.; Hohenwarter, G.K.G. Sandia National Labs., Albuquerque, NM (USA). 1989. 4p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890663–1: International superconductivity electronics conference (ISEC '89), Tokyo, Japan, 12-13 Jun 1989). Order Number DE89013560/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Superconducting polycrystalline thin films in the Tl-Ca-Bu-Cu-O system have been prepared by electron beam evaporation followed by appropriate sintering and annealing. Transition temperatures to 110 K and critical current densities to 600,000 A/cm^2 have been attained in oxygen annealed films. However, with only 16 minutes of air sintering and no oxygen anneal, oriented films have been obtained with T_c's to 107 K and J_c's to 450,000 A/cm^2. Single film devices utilizing a parallel array of weak links and a coplanar control line have been fabricated from the films. Oscillators as well as AM and FM modulators operating between 3 and 6 GHz have been demonstrated using this device concept. 24 refs., 4 figs.

33964 Fractography of glasses and ceramics. Advances in Ceramics. Volume 22. Frechette, V.D.; Varner, J.R. 445p. American Ceramic Society Inc., Westerville, OK (1988). (CONF-8608230–: Fractography of glasses and ceramics, Alfred, New York, USA, 3-6 Aug 1986).

This book collects papers on fracture mechanics in vitreous and ceramic materials. Topics include: crack branching in ceramics, fractographic determination of crack-tip stress intensity, fracture mechanisms of solid-state slab lasers, beta alumina failure in sodium-sulfur batteries, and fractography of glass.

33965 Elevated temperature sliding wear of corrosion and thermal protection coatings. Levy, A.V. (Univ. of California, Berkeley, CA (US)); January, E. v.v of Corrosion '85. National Assoc. of Corrosion Engineers, Houston, TX (1985). (CONF-850311–: National Association of Corrosion Engineers annual meeting and materials performance and corrosion show, Boston, Massachusetts, USA, 25-29 Mar 1985).

The sliding wear rates and mechanisms of several ceramic base corrosion and thermal barrier protection coating system on steel substrates were determined at elevated temperatures to 800 C.

33966 X-ray absorption study of β-nickel hydroxides. Loyselle, P.L. (Dept. of Chemistry and Chemical Engineering, Michigan Technological Univ., Houghton, MI (US)); Cornilsen, B.C.; Condrate, R.A.; Phillips, J.C. v.v of Proceedings of the Electrochemical Society fall meeting. Volume 88-2 (extended abstracts). The Electrochemical Society, Pennington, NJ (1988). (CONF-881061–: Electrochemical Society fall meeting, Chicago, Illinois, USA, 9-14 Oct 1988).

The EXAFS spectrum for ordered β-$Ni(OH)_2$ is interpreted in terms of the known crystal structure for this material and compared with the EXAFS spectra of disordered β-type hydroxides. The experimental pattern has been fitted using crystallographic bond distances and coordination numbers for the first four shells. Additional shells, at higher radii, contribute to the spectrum but do not correspond to crystallographic distances. These may involve multiple scattering events. A comparison of absorption edges (E_O) for the ordered material with those for disordered β-$Ni(OH)_2$ materials shows a dramatic shift to higher energy for the latter. Shifts in E_O are known to be dependent upon oxidation state, coordination number and type of bonding. These materials contain no active oxygen but do exhibit unique Raman spectra which indicate coordination number changes. These results indicate that care must be taken when interpreting nickel edge shifts for nickel electrode materials in terms of oxidation state changes alone. A shift in E_O may result from a change in coordination number as well as oxidation state. Coordination number changes are significant in beta-nickel hydroxides and are expected to be significant mass as well.

33967 Electrical response of electrochemical capacitors based on high surface area ruthenium oxide electrodes. Raistrick, I.D. (Los Alamos National Lab., Los Alamos, NM (US)); Sherman, R.J. v.v of Proceedings of the 1987 Electrochemical Society spring meeting: Extended abstracts. Volume 87-1. The Electrochemical Society, Pennington, NJ (1987). (CONF-870560–: 171. Electrochemical Society meeting, Philadelphia, Pennsylvania, USA, 10-15 May 1987).

It is widely known that certain metal oxide/electrolyte interfaces show very large capacities when subject to a time-varying electrical signal. Among these is RuO_2 prepared in high-surface area form by decomposition and oxidation of unstable precursors. In this paper, the electrical response of capacitors based on this material is examined and projections made concerning their potential for energy storage and power conditioning.

33968 Y-Ba-Cu-O superconducting films produced by long-pulse laser vaporization. Balooch, M. (University of California and Lawrence Berkeley Laboratory, Berkeley, California 94720(US)); Olander, D. R.; Russo, R. E. *Applied Physics Letters (USA)*, 55(2): 197-199 (10 Jul 1989). DOE Contract AC03-76SF00098.

Deposition of superconducting thin films from $YBa_2Cu_3O_7$ targets using a long-pulse (ms) Nd-glass laser with 50 J/pulse energy has been demonstrated. The deposition rate was approximately 100 nm/pulse and the film stoichiometry was close to that of the target. Scanning electron microscopy revealed spherical inclusions in the film. Scanning tunneling microscopy in air showed a terrace-ledge structure on the uniform portion of the film. A film produced by four pulses on a $SrTiO_3$ substrate, held at 540 °C, and post-annealed in O_2 at 850 °C for about 2h exhibited an onset transition at 78 K and zero resistance at 61 K. This new approach can provide fast deposition rates and broad-area film coverage per laser shot.

33969 A method for measuring optical twin spacings in the superconducting material, $YBa_2Cu_3O_x$. Verhoeven, J.D. (Ames Lab. and Dept. of Materials Science, and Engineering, Iowa State Univ., Ames, IA (US)). *Metallography (USA)*, 22(3): 245-252 (May 1989).

The optical twins in grains of the high temperature superconducting material, $YBa_2Cu_3O_x$, lie along {110} planes, and the long boundaries of elongated grains are basal planes. Equations are presented utilizing these facts, which allow the apparent twin spacing to be converted to true twin spacing by measurement of the angles between twin sets and the basal plane boundary on the polish surface. The true thickness of the elongated grains in their C axis direction may also be determined from the analysis.

33970 Micro-Raman spectroscopy of selected solid $U_xO_yF_z$ compounds. Armstrong, D. P. (Oak Ridge Gaseous Diffusion Plant, Materials and Chemistry Technology Department, P.O. Box 2003, Oak Ridge, Tennessee 37831-7271 (D.P.A., R.J.J.)); Jarabek, R. J.; Fletcher, W. H. *Applied Spectroscopy (USA)*, 43(3): 461-467 (Mar 1989). DOE Contract AC05-84OR21400.

Micro-Raman spectroscopy has been utilized to examine the spectra of solid samples of α-UF_5, β-UF_5, UF_6, three types of UO_2F_2, the powder residue from a static UF_6 release, and γ-UO_3. The spectra are presented and compared to previous literature values, with new features indicated where appropriate. With the implied constraint of proper sample handling, micro-Raman spectroscopy is a useful technique for the ready identification of uranium fluorides, oxyfluorides, and oxides.

33971 Formation of polyhedral N_2 bubbles during reactive sputter deposition of epitaxial TiN(100) films. Hultman, L. (Thin Film Group, Department of Physics, Linkoping University, S-581 83 Linkoping, Sweden(SE)); Sundgren, J.; Greene, J. E. *Journal of Applied Physics (USA)*, 66(2): 536-544 (15 Jul 1989).

Cross-sectional transmission electron microscopy has been used to investigate the formation of polyhedral N_2 bubbles in single-crystal TiN(100). Thin TiN films were deposited on MgO(100) substrates by reactive magnetron sputtering in pure N_2 atmospheres at growth temperatures T_s between 550 and 800 °C and negative substrate biases V_s between 0 and 500 V resulting in a deposition rate between 0.35 and 0.33 nm s^{-1}. The energy per incident nitrogen was $\sim eV_s/2$ and the irradiation fluxes were $\leq 2.5\times10^{15}$ N^+_2 cm^{-2} s^{-1}. Nitrogen bubbles were observed in films grown at $550 \leq T_s < 800$ °C with $V_s > 300$ V. In as-deposited films grown at $T_s = 650$ °C with $V_s = 500$ V, the bubbles were distributed in two shapes and size distributions. The largest bubbles were orthorhombohedra, i.e., cubes elongated along [100] directions normal to the growth direction, with 5–20 nm faces on {100} planes most of which exhibited {110} and {111} faceting. Small ($\leq$5 nm) octahedral bubbles with {111} faces were also observed. In situ annealing experiments in the transmission electron microscope showed that the bubbles transformed from orthorhombohedra to octahedra at $T_s = 350$ °C and then returned to orthorhombohedral shape with either continued heating to $T_s = 600$ °C or upon cooling to room temperature. Assuming quasiequilibrium conditions, the surface energy γ of N_2 bubbles in TiN was found to be anisotropic and to vary as $\gamma_{100} < \gamma_{110} < \gamma_{111}$.

33972 Effects of compositional variations on the properties of superconducting $(Bi,Pb)_2Sr_2Ca_2Cu_3O_\delta$. Green, S. M. (Department of Electrical and Computer Engineering, University of California, San Diego, La Jolla, California 92093(US)); Mei, Y.; Manzi, A. E.; Luo, H. L.; Ramesh, R.; Thomas, G. *Journal of Applied Physics (USA)*, 66(2): 728-734 (15 Jul 1989). DOE Contract AC03-76SF00098.

The results of a systematic study on compositional variations within the $Bi_{2-x}Pb_xSr_2Ca_2Cu_3O_\delta$ superconducting system are reported. It is found that a secondary phase (or phases), likely composed of Pb-Sr-Ca-Cu-O, forms when x exceeds 0.35, indicating that this is an upper limit on the amount of Pb which replaces Bi.

Varying the Sr:Ca or Bi:Ca ratio has dramatic effects on the resistive and magnetic properties. It is suggested that there is a very limited range of solution among the alkaline-earth elements. Bi occupying Ca sites is probably deleterious for both T_c and the structural stability of the 2223 phase. Preliminary results on textured ceramic samples have yielded J_c (77 K) as high as 580 A/cm^2 .

33973 Optical properties of electrochromic vanadium pentoxide. Cogan, S. F. (EIC Laboratories Incorporated, 111 Downey Street, Norwood, Massachusetts 02062(US)); Nguyen, N. M.; Perrotti, S. J.; Rauh, R. D. *Journal of Applied Physics (USA),* 66(3): 1333-1337 (1 Aug 1989).

Electrochemical and spectroscopic measurements were used to characterize the electrochromic behavior of sputtered V_2O_5 films. In response to lithium intercalation, the fundamental optical absorption edge of V_2O_5 shifts to high energies by 0.20–0.31 eV as the lithium concentration increases from $Li_{0.0}V_2O_5$ to $Li_{0.86}V_2O_5$. There is a corresponding increase in the near-infrared absorption that exhibits Beer's law behavior at low lithium concentrations. The shift in absorption edge results in a large decrease in absorbance in the 350–450 nm wavelength range. This effect is most prevalent in thin films which exhibit a yellow to colorless optical modulation on lithium intercalation. The cathodic coloration in the near infrared is relatively weak with a maximum coloration efficiency of 35 cm^2/C.

33974 Clean boundary between anisotropic superconductors as a weak link. Kogan, V. G. (Ames Laboratory and Department of Physics, Iowa State University, Ames, Iowa 50011(US)). *Physical Review Letters (USA),* 62(25): 3001-3003 (19 Jun 1989). DOE Contract W-7405-ENG-82.

If two anisotropic superconductors are in perfect contact, the persistentcurrent normal to the interface must be accompanied by spontaneous creation ofa vortex chain at the boundary (in zero external field). The phenomenon is dueto peculiar boundary conditions which should be imposed upon currents at theinterface. The vortices are subject to the Lorentz force along the interface,thus providing the possibility of an extra dissipation and reduction of the critical current across the grain boundary.

33975 Reply to "Comment on 'Identification of a superoxide in superconducting $La_2CuO_{4-\delta}$ by x-ray photoelectron spectroscopy' ". Rogers Jr., J. W. (Sandia National Laboratories, Albuquerque, New Mexico 87185-5800(US)); Shinn, N. D.; Schirber, J. E.; Venturini, E. L.; Ginley, D. S.; Morosin, B. *Physical Review [Section] B: Condensed Matter (USA),* 39(16): 12334-12335 (1 Jun 1989). DOE Contract AC04-76DP00789.

New and interesting results are presented which complement our previously published conclusions on the presence of a superoxide phase in the near-surface region of superconducting ceramic lanthanum cuprate. Although we disagree with some of the data interpretation of Zhou, Sinha, and Goodenough [Phys. Rev. B 39 (to be published)], their Comment nevertheless emphasizes the difficulties in determining the species responsible for the observed superconductivity in the absence of a direct spectroscopic probe of excess oxygen in the bulk material.

3606 Other Materials

Refer also to citation(s) 33069, 33101, 33161, 33359, 33394, 33443, 33444, 33612, 33615, 33631, 33632, 33690, 33695, 33704, 33776, 33820, 33835, 33851, 33900, 33964, 34065, 34094, 34116, 34135, 34150, 34191, 34757, 34926, 34927

33976 (CONF-890426–16) **Refractive index of silicate glasses implanted with copper.** Weeks, R.A.; Hosono, H.; Zuhr, R.A.; Magruder, R.; Mogul, H. Oak Ridge National Lab., TN (USA). 1989. 6p. Sponsored by DOE Energy Research. DOE Contract AC05-84OR21400. From Spring meeting of the Materials Research Society; San Diego, California, USA; 24-28 Apr 1989. Order Number DE89013062/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The refractive indices and optical absorptions of Cu implanted glasses have been measured. Silica and two silicate glasses have been implanted with Cu^+ to nominal doses ranging from 3 x 10^{15}cm^{-2} to 6 x 10^{16}cm^{-2} at an energy of 160KeV and currents of ~4μAcm^{-2}. Substrate temperatures, during implantation, ranged from ~100K to 700K. Both refractive index and optical absorption of the silica are functions of dose and substrate temperature. Neither of these properties are significantly altered in the silicate glasses for any dose or substrate temperature. The observed increases in the index of the implanted silica are attributed to an optical band due to Cu^0 colloids. 10 refs., 4 figs., 1 tab.

33977 (CONF-890627–1) **Statistics of fracture in two grades of isotropic graphite.** Kennedy, C.R.; Montgomery, S. Oak Ridge National Lab., TN (USA). 1989. 2p. Sponsored by DOE Energy Research. DOE Contract AC05-84OR21400. From 19. biennial conference on carbon; University Park, Pennsylvania, USA; 25-30 Jun 1989. Order Number DE89013703/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A test program to determine the flexure strength of graphite grades 2020 and IG-11 has been accomplished. Within three billets of each grade, bend samples were taken from three different orientations in three separate positions. The test data were statistically evaluated using one-way and two-way analyses of variance. Using Bartlett's test, homogeneity of variance for strength was clearly a tenable hypothesis of the 27 separate populations for both graphite grades. 2 refs., 3 figs., 3 tabs.

33978 (DOE/ER/01198–T14, pp. 447-463) **Properties of crystalline and liquid condensed gases.** Simmons, R.; Pandharipande, V. Illinois Univ., Urbana, IL (USA). Materials Research Lab. Mar 1988. In *Materials Research Laboratory: Renewal proposal for the extension in time and funds.* Order Number DE88013776/JAW. Available from NTIS, PC A99/MF A01; 1.

Crystalline and liquid materials subjected to extreme variations in pressure, temperature, and other stresses are elements of advanced energy systems. Material properties frequently involve atomic dynamics and structural phase transitions. Direct evidence about these microscopic properties can be obtained by suitable scattering techniques, applied to study either model systems or systems of technological importance, and by sophisticated calculations. In this project various approaches, both experimental and theoretical, are being made to fundamental problems in this area. The helium isotopes and their mixtures form model systems for which many promising possibilities for study remain. The ANL Intense Pulsed Neutron Source is used to measure directly single-particle momentum distributions in various condensed phases over a wide range of densities and interatomic interaction strengths. These include solid and liquid noble gases (^{3}He,^{4}HE, Ne, Ar,...), hydrogen, and selected mixtures. Complementary x-ray scattering is done on crystal specimens. X-ray study of point defect properties, and of isotopic phase changes, pursues questions of the microscopic character of defect and atomic structure and mobilities. The various fluid heliums are instructive challenges for the development of theoretical methods for fluids and fluid drops, including real nuclei, nuclear matter, and very small semi-classical droplets. Fundamental theoretical studies of ^{3}He and ^{4}He fluids proceed from the pair interaction through many-body theories of structure to predict experimentally observable properties of the ground state, of inhomogeneous and thermally excited materials, and of surface properties and excitations of liquid drops.

33979 (DOE/ER/01198–T14, pp. 577-634) **Field responsive polymeric and organometallic materials.** Stupp, S.I. Illinois Univ., Urbana, IL (USA). Materials Research Lab. Mar 1988. In *Materials Research Laboratory: Renewal proposal for the extension in time and funds.* Order Number DE88013776/JAW. Available from NTIS, PC A99/MF A01; 1.

This proposal describes a program on synthesis of new organic and organometallic materials with molecular structures designed to respond strongly to magnetic, electric and optical fields. The scope of this program covers largely unexplored phenomena such as the organization of organic or organometallic molecules into ferromagnetic or ferroelectric structures and their field response leading to stored energy or configurational changes. The scope also covers the polarization response of organic or organometallic molecules to the high optical fields of laser beams. The initial stages of this program emphasize chemical synthesis of new materials, with gradual integration of the physical and theoretical aspects of the subject. In the area of magneto-active materials work is proposed on ferromagnetic ordering in structures containing organometallic acceptors and

organic donors (Hendrickson and Rauchfuss). A number of new materials of interest in nonlinear optics will be investigated by Suslick, Hendrickson and Rauchfuss. These include, polymeric ferrocenes with pendant groups, cubane metal clusters bearing polymerizable organic substituents, and metalloporphyrin assemblies. Chiral liquid crystal polymers containing highly dipolar bonds of interest for ferroelectric ordering, electrical memory and chiral recognition will be investigated by Stupp. Stupp and Brown will investigate the synthesis of organometallic liquid crystal polymers with anisotropic semiconducting and optical properties. Colloidal particles of conducting polymers such as polyaniline will be studied by Zukoski. Klemperer, Faulkner, Zukoski and Payne will study a class of compounds in which field-active organic molecules can be trapped within high symmetry silica cages.

33980 (IAEA-TECDOC–486, pp. 25-54) **Applications of ionizing radiation and plasma gas discharge processing in medicine and biotechnology.** Hoffman, A.S. (Washington Univ., Seattle (USA). Center for Bioengineering). International Atomic Energy Agency, Vienna (Austria). Dec 1988. (CONF-8706397–: Final research co-ordination meeting on application of radiation technology in immobilization of bioactive materials, Beijing, China, 15-18 Jun 1987). In *Radiation technology for immobilization of bioactive materials. Proceedings of the final research co-ordination meeting held in Beijing, 15-18 June 1987.* Order Number DE89617908/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

This article reviews the work carried out over the period 1970-1987 in the laboratories of Prof. A.S. Hoffman at the University of Washington, Seattle, Washington concerning use of ionizing radiation and plasma gas discharge to synthesize and/or modify polymeric biomaterials for therapeutic, diagnostic, bioprocess and bioseparation applications. Specific data examples, both published and unpublished, are included only covering the period of the IAEA Coordinated Research Program on "Application of Radiation Technology in Immobilization of Bioactive Materials",1983-1987. Since this publication is meant to be solely a review of the research program of Professor Hoffman in this field, the bibliography only includes references to these studies. (author). 30 figs, 10 tabs.

33981 (INIS-mf–11982, pp. 10.1-10.14) **Attempts to explain strength increase due to high rate loading.** Eibl, J. (Karlsruhe Univ. (T.H.) (Germany, F.R.). Inst. fuer Massivbau und Baustofftechnologie); Curbach, M. Staatliche Materialpruefungsanstalt, Stuttgart (Germany, F.R.); Karlsruhe Univ. (T.H.) (Germany, F.R.). Inst. fuer Massivbau und Baustofftechnologie. 1987. (In German). (CONF-8710410–: 13. MPA seminar on safety and reliability of pressure components: the contribution of component and large specimen testing to structural integrity assessment methodology, Stuttgart, Germany, F.R., 8-9 Oct 1987). In *Safety and reliability of pressure components with special emphasis on the contribution of component and large specimen testing to structural integrity assessment methodology. Vol. 1. Fracture mechanics, dynamic loading, nondestructive testing, radiation embrittlement.* Order Number DE89783126/JAW. Available from NTIS (US Sales Only), PC A99/MF A01.

The conclusion is drawn from investigations conducted with concrete that the strain rate-dependent variations above all originate from the contribution of the materials irreversible deformation. The internal stress distributions of a truly heterogeneous material (on an intermediate level) differ according to the strain rate imposed. The different general magnitudes (integral values) of the stress distributions lead to differences in the external mean stress (i.e. also the strengths of a homogeneous equivalent continuum) upon which the macroscopic observations are usually based. So-called 'dynamic strengths' are therefore not necessarily existent.

33982 (INIS-SU–80, pp. 37-41) **X-ray-electron spectroscopy of diamond-like carbon films.** Vakula, S.I. (AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst.); Strel'nitskij, V.E.; Timoshenko, A.I.; Pershin, V.F.; Shpilinskij, L.F. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. (In Russian). In *Physics of radiation defects and radiation materiss science. Scientific-technical collection.* Order Number DE89012114/JAW. Available from NTIS (US Sales Only), PC A05/MF A01; INIS.

Voprosy atomnoj nauki i tekhniki.; no. 3(41).

X-ray electron spectroscopy of diamond-like carbon films is carried out. The valent state of carbon atoms, density of structural elements in the condensate near-the-surface layer are determined. Change of the condensate surface structure under Ar ion bombardment is detected. 11 refs.; 3 figs.; 2 tabs.

33983 (INIS-SU–80, pp. 57-59) **Electron radiation influence on glass optical properties.** Shevyakova, Eh.P. (AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst.); Lifshits, E.V.; Polyashenko, R.F. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. (In Russian). In *Physics of radiation defects and radiation materiss science. Scientific-technical collection.* Order Number DE89012114/JAW. Available from NTIS (US Sales Only), PC A05/MF A01; INIS.

Voprosy atomnoj nauki i tekhniki.; no. 3(41).

Crystallooptic and IR spectroscopy methods are used to study the influence of electron radiation on glass optical properties depending on their chemical composition and phase uniformity. Glasses of natural minerals (albite $NaAlSi_3O_8$, orthoclase $LAlSi_3O_8$, nepheline $KSiAlO_4$), synthetic compounds ($CaMgSiMo_4$, $Ca_2MgSi_2O_7$, Na_2MgSiO_4) and eutectic composition $Na_2Ca_2Si_2O_7$-$Ca_2MgSi_2O_7$ system are investigated. It is stated that electron irradiation (E=6 and 10 MeV, doses $5x10^{22}$-$1x10^{23}$ eV/m^2) results in change of IR spectra and glass optical properties, decrease of their transparence, increase of refraction factors, formation of incipient crystallization nuclei (up to 10 ... 15%). Comparison of the degree of radiation-induced glass changes and crystalline differences of the same composition is carried out. A conclusion is drawn that optical properties of amorphous substance are less changed. 5 refs.; 2 figs.; 1 tab.

33984 (JAERI-M–88-238) **Irradiation effects on resistance of thermal impact of composite used in space.** Sasuga, Tsuneo; Egusa, Sigenori; Udagawa, Akira and others. Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1988. 34p. (In Japanese). Order Number DE89778069/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Electron irradiation effects on mechanical properties at low(-100degC), high(100degC) and room temperatures, and on the cyclic thermal impact from high(100degC) to low(-90degC) were studied for IM-6/R376 composite in which modified TGDDM-DDS matrix was reinforced by a high strength inter mediate modules carbon fiber(IM-6) and T-300/3601 composite which was composed of non-modified TGDDM-DDS matrix and a high strength carbon fiber(T-300), and then adaptability of these materials to environments of space was evaluated. LISS was decreased by irradiation over 10 MGy in IM-6/R6376 composite and 20 MGy in T-300/3601 composite, but the tensile and compression strength at low, high and room temperatures were scarcely affected by irradiation up to 10 MGy. When unirradiated T-300/3601 composite was subjected by thermal impact, many microcracks were produced and the compression strength decrease to 90% of the initial value but the production on microcrack and decreasing in the compression strength by thermal impact tended to become less in the irradiated specimen. On the other hand, in the unirradiated IM-6/R6376 composite production of microcrack was not observed by thermal impact and decrease in strength was less but microcracks were procuced and the strength decrease by thermal impact after irradiation. In the case of irradiation after thermal impact, radiation effects were not observed. It was concluded from these results that the both composites have enough resistance against environmental radiation in space, and IM-6/R6376 composite is excellent more than T-300/3601 composite in consideration of resistane for thermal impact.

33985 (PB–89-856322/XAB) **Metal-organic chemical vapor deposition: semiconductor crystal growth on various substrates. August 1977-February 1989 (Citations from the International Aerospace Abstracts data base). Report for August 1977-February 1989.** National Technical Information Service, Springfield, VA (USA). Feb 1989. 67p. Available from NTISPC N01/MF N01.

U.S. sales only.

This bibliography contains citations concerning developments in metal-organic chemical vapor deposition (MOCVD) technology for crystal growth of semiconductor structures and devices on various substrates. Topics include quantum well structures, heterostructure lasers, photoconductive and optoelectronic devices, microwave devices, and solar cells fabricated by MOCVD techniques. Characteristics of MOCVD developed materials and devices, MOCVD growth processes, and MOCVD reactors are also presented. (Contains 131 citations fully indexed and including a title list.)

33986 (SAND–89-0664C) **Molecular sieve films from zeolited-silica microcomposites.** Bein, T.; Brown, K.; Brinker, C.J. Sandia National Labs., Albuquerque, NM (USA). 1989. 10p. Sponsored by DOE/DP;OGA. DOE Contract AC04-76DP00789. (CONF-890705–2: 8. international zeolite conference, Amsterdam, Netherlands, 10-14 Jul 1989). Order Number DE89009831/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Inorganic thin films with molecular sieving properties have been formed by embedding microcrystals of zeolite Y and chabazite in a glassy silica matrix. The silica matrix was derived from sols prepared from tetraethylorthosilicate hydrolyzed under either acidic or basic conditions in alcoholic solution. Dip-coating, deposition of suspensions, or coating of zeolite dispersions with the glassy silica matrix were used to create the zeolite-silica films. The access of different probe molecules into the zeolitic part of the thin film was examined with in situ FTIR techniques and temperature-programmed-desorption studies. With all combinations of deposition techniques and silica matrices, the resulting films showed the molecular sieving properties of the parent zeolite. 15 refs., 4 figs., 2 tabs.

33987 (SAND–89-1282C) **High voltage considerations for Silicon-on-Insulator devices using porous silicon.** Guilinger, T.R.; Kelly, M.J.; Tsao, S.S.; Cristensen, T.M.; Schubert, W.K. Sandia National Labs., Albuquerque, NM (USA). 1989. 10p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract AC04-76DP00789. (CONF-890518–3: 175. meeting of the Electrochemical Society, Los Angeles, California, USA, 7-12 May 1989). Order Number DE89013162/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We describe a Silicon-on-Insulator (SOI) structure for high voltage BICMOS uniquely suited to the use of porous silicon (PS). In this SOI structure, bulk, high speed bipolar devices are readily integrated with CMOS high voltage and logic devices (smart power). To investigate the processing compatibility of PS with this structure, we measured breakdown strength and etch rate of thermally treated PS in 7:1 buffered oxide etch (BOE) and determined that they can approach values typical of thermal silicon oxides/nitrides. 7 refs., 2 figs.

33988 (STU–86-3932) **Theoretical study of conducting polymers and polymer-metal interfaces.** Stafstroem, S. Swedish National Board for Technical Development, Stockholm (Sweden). 29 Apr 1988. 20p. (In Swedish). Order Number DE89776224/JAW. Available from NTIS (US Sales Only), PC A03/MF A01;1.

Effects of doping of conjugated polymers was studied by quantum chemical calculation methods. The process transforms the polymer from a semiconductor into a good electrical conductor. The geometrical relaxation and changes in the electronic structure were determined under the doping process. Very satisfactory agreement with experimental data was obtained for low and moderate doping levels. For highly doped polyaniline a so-called polaron lattice is suggested. This lattice configuration has also been tested for polyacetylene and polythiophene and good results were obtained when compared with experimental data. In direct cooperation with IBM a preliminary study of polyimid-copper interfaces was done. The electronic structure for free polyimid was computed and an unambiguous interpretation of experimental investigations of the electronic structure was obtained. Also studied was a phtalimid-copper complex which serves as a model system for polyimid-copper interfaces. (O.S.).

33989 (UCRL–21206) **Processing of continuous fiber composites: Final report.** Higgins, B.G.; Powell, R.L.; Hsieh, You-Lo. Lawrence Livermore National Lab., CA (USA); California Univ., Davis, CA (USA). Feb 1989. 32p. Sponsored by DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE89012608/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This report covers the first year progress in the four main areas of this project. The goal of this project are: the characterization of single carbon fibers by wetting studies and SEM; the kinetics of impregnation into carbon fiber bundles (tows): (a) axial, (b) normal; the factors affecting void formation in carbon fiber composites; and process simulations and optimization. (JL)

33990 (UCRL–99832) **Photoelectronic properties of low temperature GaAs grown on GaAs and silicon substrates by molecular epitaxy.** Mariella, R.P.; Morse, J.D.; Aines, R.; Hunt, C.E. Lawrence Livermore National Lab., CA (USA). 25 Apr 1989. 6p. Sponsored by DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-890426–17: Spring meeting of the Materials Research Society, San Diego, California, USA, 24-28 Apr 1989). Order Number DE89013148/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The characteristics of GaAs layers grown by MBE at growth temperatures from 200°C to 400°C have been evaluated by photoconductivity experiments in order to understand the photoelectronic properties of this material. Low temperature (LT) growth of GaAs on both silicon and GaAs substrates has been investigated in an attempt to better understand the nature defects which are created in epitaxial layers grown under these conditions. Results from experiments on both annealed and unannealed LT samples indicate that the electronic transport properties of the epilayers can be controlled by selecting the appropriate growth conditions. 7 refs., 4 figs., 1 tab.

33991 Measurements of melt depth limited diffusion in gas immersion laser doped silicon using an improved laser system. Weiner, K.H. (Lawrence Livermore National Labs., Livermore, CA (US)); McWilliams, B.M. v.v of Proceedings of the symposium on laser processes for microelectronic applications. Ritsko, J.J.; Ehrlich, D.; Kashiwagi, M. The Electrochemical Society, Pennington, NJ (1988). (CONF-8710331–: Symposium on laser processes for microelectronic applications, Honolulu, Hawaii, USA, 21-22 Oct 1987).

A new Gas Immersion Laser Doping (GILD) system capable of numerous n-situ diagnostic measurements is described. The new system is designed to use the diagnostic capabilities in conjunction with a workstation and process simulators to predict in real time the outcome of the doping process. A more advanced gas system is also described. The new equipment is used to characterize junction depth as a function of laser fluence and silicon surface melt duration. Both N ad P doped regions are analyzed and the resulting data compared to simulated results. Results on process uniformity are also presented.

33992 Laser doping of semiconductors. Sigmon, T.W. (Stanford Electronics Labs., Stanford, CA (US)). v.v of Proceedings of the symposium on laser processes for microelectronic applications. Ritsko, J.J.; Ehrlich, D.; Kashiwagi, M. The Electrochemical Society, Pennington, NJ (1988). (CONF-8710331–: Symposium on laser processes for microelectronic applications, Honolulu, Hawaii, USA, 21-22 Oct 1987).

A XeCl pulsed uv-excimer laser is used for the incorporation and/or redistribution of dopant impurities in silicon. A localized region of a silicon wafer is melted and the dopant, present as a thin surface film and in the gas phase, diffuses into the molten silicon. The process can result in high concentration, shallow, box-like profiles suitable for submicron VLSI device fabrication. Excellent crystalline and electrical properties of the doped layers result, without post-doping anneal, for laser parameters yielding devices suitable VLSI.

33993 Characterization of diodes fabricated using the Gas Immersion Laser Doping (GILD) process in silicon. Carey, P.G. (Solid State Electronics Labs., Stanford, CA (US)); Sigmon, T.W. v.v of Proceedings of the symposium on laser processes for microelectronic applications. Ritsko, J.J.; Ehrlich, D.; Kashiwagi, M. The Electrochemical Society, Pennington, NJ (1988). (CONF-8710331–: Symposium on laser processes for microelectronic applications, Honolulu, Hawaii, USA, 21-22 Oct 1987).

The authors report the electrical and structural characterization of diodes fabricated using the Gas Immersion Laser Doping (GILD) process in silicon. Electrical measurements show that ideal forward

currents, low reverse leakage currents, and dopant activations of 100% result for GILD diodes that have not been annealed at high temperature. In addition, SEM, SIMS, and RBS structural characterization shows that no visible oxide or silicon damage occurs following laser doping, and that ultra-shallow (<500A), high concentration (in excess of $1x10^{21}$ atoms-cm^{-3}) profiles can be obtained while maintaining excellent crystallinity of the doped structure. These results indicate that the GILD process is ideally suited to fabricate shallow n^+ and p^+ junctions suitable for VLSI as well as In-situ based processes.

33994 Fracture of solid state lasers. Marion, J.E. (Univ. of California, Lawrence Livermore National Lab., Livermore, CA (US)). v.v of Advances in nonlinear polymers and inorganic crystals, liquid crystals, and laser media. Musikant, S. SPIE Society of Photo-Optical Instrumentation Engineers, Bellingham, WA (1987). (CONF-8708234–: Advances in nonlinear polymers and inorganic crystals, liquid crystals, and laser media, San Diego, California, USA, 20-21 Aug 1987).

The understanding of fracture in solid state lasers is reviewed, with an emphasis on fracture of high average power thin slabs. Methods for characterizing strength in the context of materials selection and device implementation are discussed. Progress in slab strengthening is analyzed; aggressive optical fabrication research (to give low damage surfaces), coupled with the implementation of existing schemes for placing the slab surfaces in compression, are recommended to reduce the problem of slab fracture.

33995 A perspective on nitrogen in silicon. Stein, H.J. (Sandia National Labs., Albuquerque, NM (US)). v.v of Oxygen, carbon, hydrogen and nitrogen in crystalline silicon. Mikkelsen, J.C.; Pearton, S.J.; Corbett, J.W.; Pennycook, S.J. Materials Research Society, Pittsburgh, PA (1986). (CONF-8512141–: Oxygen, carbon, hydrogen and nitrogen in crystalline silicon, Boston, Massachusetts, USA, 2-5 Dec 1985).

Much of what is known about the behavior of nitrogen in Si has come from studies of nitrogen-ion-implanted Si. This includes off-center substitutional nitrogen centers, nitrogen pairing and nitrogen aggregation. The predominant mode for incorporating nitrogen into Si is in pairs for processing conditions ranging from doping in the melt to pulsed laser annealing of ion-implanted Si. The strength of an infrared absorption band associated with the pair centers has been calibrated against nitrogen concentrations determined by nuclear reaction analysis of nitrogen in Si. From this calibration the accuracy for determining a nitrogen concentration level from the strength of an infrared absorption band in probably as good as that for determining oxygen concentrations by infrared absorption, and has the same limitations. That is, nitrogen which is complexed with other impurities or other defects and aggregated nitrogen does not contribute to the intensity of the absorption band. In addition, band intensities for nitrogen are generally weaker than those for oxygen due to lower concentrations in melt-doped material.

33996 Fourier-filtering techniques for the analysis of high-resolution pulsed neutron powder diffraction data. Richardson, J.W. Jr. (Argonne National Lab., Argonne, IL (US)); Faber, J.; Pluth, J.J.; Smith, J.V. v.v of Proceedings of the American Crystallographic Association. American Crystallographic Association, New York, NY (1986). (CONF-850877–: American Crystallographic Association meeting, Stanford, California, USA, 18-23 Aug 1985).

Rietveld profile refinements using high-resolution pulsed neutron powder diffraction data, often reveal broad background intensity contributions from sources other than the crystalline materials being studied. Pulsed neutron sources are unique in their resolution and intensity characteristics, making these contributions especially prominent. The presence of uncorrected background intensity significantly hampers standard Rietveld refinement, and its removal and/or identification is imperative for successful refinement of the crystalline structure. Uncorrected background can be removed by fitting it with an empirical function. Alternatively, if the source of the diffuse scattering is known, a more complete accounting of the physics can be made by modelling the diffuse scattering along with the crystalline. In most cases, one has incomplete understanding of the sources of the diffuse scattering, so a compromise is useful. Using a Fourier-filtering technique, the authors are able to remove non-crystalline contributions to the overall scattering pattern, while obtaining information about the non-crystalline material. Fourier transformation of background intensity not removed by the Rietveld procedure results in a real-space Radial Distribution Function (RDF) for the non-crystalline component in the sample. This component is usually due either to a separate non-crystalline phase or to short range ordering within the crystalline sample. Important considerations when applying this type of technique are how the crystalline refinement is effected by the removal of the diffuse background, and how accurately and completely the non-crystalline material can be modelled. Investigations to be made into this, using a variety of experimental conditions are discussed, along with applications of the technique in the refinement of molecular sieve structures.

33997 Time-dependent damage and creep of brittle rock. Costin, L.S. (Geomechanics Div. 1542, Sandia National Labs., Albuquerque, NM (US)). v.v of Damage mechanics and continuum modeling. Stubbs, N.; Krajcinovic, D. American Society of Civil Engineers, New York, NY (1985). (CONF-851039–: American Society of Civil Engineers fall meeting, Detroit, Michigan, USA, 23 Oct 1985).

In this paper, some results of a combined analytical-experimental study of the relationship between subcritical microcrack growth due to stress corrosion and the time-dependent deformation and failure of brittle rock are reported. An analysis of creep and failure under uniaxial stress was performed using a continuum damage model. The model includes evolutionary equations which describe the growth of microcracks due to stress corrosion as well as incremental increases in applied stress. Also, the effect of interaction between neighboring cracks on the rate of crack growth is included. The model was used to predict the relationship between strain rate and failures stress for uniaxial compression at constant strain rate. These results are compared to the results of uniaxial compression experiments on Tennessee marble. A further implication of the analytical results is that if the material is stressed below a threshold stress level and allowed to creep, the creep rate should decay to zero over time and no failure occur. However, if the threshold stress level is exceeded, the damage level continues to evolve, resulting in an eventual acceleration of the creep rate (tertiary creep) and failure.

33998 Origin of fractal structures in amorphous materials. Schaefer, D.W. (Sandia National Labs., Albuquerque, NM (US)); Keefer, K.D. v.v of Factal aspects of materials: Metal and catalyst surfaces, powders and aggregates. Extended abstracts. Mandelbrot, B.B.; Passoja, D.E. Materials Research Society, Pittsburgh, PA (1984). (CONF-841157–: Materials Research Society annual meeting, Boston, Massachusetts, USA, 26-29 Nov 1984).

With the exception of electronic materials, random structures are extremely prevalent in metallic, ceramic and organic materials. It is evident that random structures in solid materials reflect random growth processes such as polymerization, aggregation and phase separation. Prior to the application of the concept of fractal geometry, random materials eluded characterization. The authors demonstrate by small angle x-ray scattering (SAXS) that a variety of amorphous materials are fractal. Because of the close connection between fractal structures and random growth processes, the authors suggest that the manipulated through control of the underlying growth process. This idea is illustrated by porous silica aerogel where the structure of the porous solid is traced to aggregation and polymerization processes in the solution precursor. Although there are many classes of fractal objects, all have the common characteristic that the structures factor, S(q), measured in a scattering experiment, is power-law in q, the magnitude of the scattering vector, $S(q) - q^{-x}$.

33999 Dynamic light scattering from fractal colloidal aggregates. Martin, J.E. (Sandia National Labs., Albuquerque, NM (US)); Schaefer, D.W.; Ackerson, B.J. v.v of Factal aspects of materials: Metal and catalyst surfaces, powders and aggregates. Extended abstracts. Mandelbrot, B.B.; Passoja, D.E. Materials Research Society, Pittsburgh, PA (1984). (CONF-841157–: Materials Research Society annual meeting, Boston, Massachusetts, USA, 26-29 Nov 1984).

Recently, light scattering measurements have been reported for dilute solutions of aggregates of colloidal silica. These measurements demonstrated a power-law dependence of the scattered intensity,I, on the momentum transfer, q, giving $I - q^{2.12}$. Calculations gave a precise meaning to this exponent; the scattering

exponent, d_s, relates the z-averaged radius of gyration, R_z, to the weight averaged mass, M_w, through $R_z{}^{d_s} \sim Mw$. Unfortunately, the results cannot be directly related to any growth model since no model gives ~2.1 for the scattering exponent. Specifically, the two most likely models, cluster-cluster aggregation and percolation, give $d_s = 1.75$ and $d_s = 2.0$ respectively, and so cannot be clearly identified as the growth process.

34000 High resolution x-ray investigation of stage purity and staging transitions. Misenheimer, M.E. (Dept. of Physics, Univ. of Illinois at Urbana-Champaign, IL (US)); Zabel, H. v.v of Graphite intercalation compounds. Eklund, P.C.; Dresselhaus, M.S.; Dresselhaus, G. Materials Research Society, Pittsburgh, PA (1984). (CONF-841157–: Materials Research Society annual meeting, Boston, Massachusetts, USA, 26-29 Nov 1984).

In-situ measurements of (OOiota) Bragg-profiles of potassium-graphite intercalation compounds, using triple-axis x-ray diffraction techniques, indicate that the maximum purity of a stage n compound decreases with increasing stage number. The transition region between stages exhibits, however, a miscibility gap, whose size decreases with higher stages.

34001 Dispersion measurements of microcrystals in the near ultraviolet and infrared. Davis, L.E. (Lawrence Livermore Lab., Livermore, CA (US)). v.v of Current developments in optical engineering II. Fischer, R.E.; Smith, W.J. SPIE Society of Photo-Optical Instrumentation Engineers, Bellingham, WA (1987). (CONF-8708232–: Current developments in optical engineering II, San Diego, California, USA, 18-21 Aug 1987).

Procedures for measuring the linear optical properties of small, transparent crystals are described. Using a spindle stage refractometer, the refractive indices for light from 0.38 to 1.10 μm can be determined. The methods are employed to study new nonlinear crystals to evaluate their potential as second and third harmonic generators of light at 1.064 μm. The measurements can be made on single crystal fragments as small as 50 μm, thus permitting preliminary evaluations to be made prior to extensive crystal growth efforts.

34002 Optical second harmonic generation from Langmuir-type molecular monolayers. Berkovic, G. (Dept. of Physics, Univ. of California, Center for Advanced Materials, Lawrence Berkeley Lab., Berkeley, CA (US)); Rasing, T.; Shen, Y.R. v.v of Advances in nonlinear polymers and inorganic crystals, liquid crystals, and laser media. Musikant, S. SPIE Society of Photo-Optical Instrumentation Engineers, Bellingham, WA (1987). (CONF-8708234–: Advances in nonlinear polymers and inorganic crystals, liquid crystals, and laser media, San Diego, California, USA, 20-21 Aug 1987).

A single molecular layer is generally sufficient to produce observable optical second harmonic generation (SHG). Furthermore, the selection rules governing this process make the SHG from a single monolayer often stronger than that from the medium supporting the monolayer. The authors have studied SHG from various Langmuir-type monolayers (i.e. monolayers spread on a water surface) in the following contexts: Study of chemical reactions (e.g. polymerization) and two-dimensional phase transitions in molecular monolayers on water, and Development of a new technique to evaluated optical nonlinear coefficients of organic molecules, and their relationship to the molecular structure.

34003 Organic nonlinear crystals and high power frequency conversion. Velsko, S.P. (Univ. of California, Lawrence Livermore National Lab., Livermore, CA (US)); Davis, L.; Wang, F.; Monaco, S.; Eimerl, D. v.v of Advances in nonlinear polymers and inorganic crystals, liquid crystals, and laser media. Musikant, S. SPIE Society of Photo-Optical Instrumentation Engineers, Bellingham, WA (1987). (CONF-8708234–: Advances in nonlinear polymers and inorganic crystals, liquid crystals, and laser media, San Diego, California, USA, 20-21 Aug 1987).

The authors are searching for new second and third harmonic generators among the salts of organic acids and bases. They discuss the relevant properties of crystals from this group of compounds, including their nonlinear and phasematching characteristics, linear absorption, damage threshold and crystal growth. In addition, they summarize what is known concerning other nonlinear optical properties of these crystals, such as two-photon absorption, nonlinear refractive index, and stimulated Raman thresholds. A preliminary assessment is made of the potential of these materials for use in future high power, large aperture lasers such as those used for inertial confinement fusion experiments.

34004 Neutron scattering studies of graphite intercalation compounds. Kamitakahara, W.A. (Ames Lab. USDOE, Iowa State Univ., Ames, IA (US)). v.v of Graphite intercalation compounds. Eklund, P.C.; Dresselhaus, M.S.; Dresselhaus, G. Materials Research Society, Pittsburgh, PA (1984). (CONF-841157–: Materials Research Society annual meeting, Boston, Massachusetts, USA, 26-29 Nov 1984).

The use of neutron scattering to investigate graphite intercalation compounds (GICs) has greatly increased over the past few years. Prior to about 1980, only a single limited study on RbC_8 had been published, but neutron methods are now (1984) among the more common techniques employed on GICs. Neutrons offer a number of advantages in this area. Both structural and dynamical information can be obtained, usually on the same samples in a single experiment. The information is often unique, e.g., as in the case of diffusion studies by quasi-elastic neutron scattering (QENS), and the spectroscopy of q not equal O phonons.

34005 C-axis layer structure of stage 1,2 Graphite-KHg. Yang, M.H. (Univ. of Kentucky, Lexington, KY (US)); Eklund, P.C.; Kamitakahara, W.A. v.v of Graphite intercalation compounds. Eklund, P.C.; Dresselhaus, M.S.; Dresselhaus, G. Materials Research Society, Pittsburgh, PA (1984). (CONF-841157–: Materials Research Society annual meeting, Boston, Massachusetts, USA, 26-29 Nov 1984).

The ternary Graphite-KHg Intercalation Compounds have been the subject of much recent attention because of their unusual anisotropic superconducting properties. Electron diffraction studies have indicated that several in-plane superlattices are possible in the stage 1 compound: referred to the graphitic in-plane lattice vectors, the formation of (2x2)R O^0. Recently, two neutron scattering studies of the structure and phonon properties of the stage 1 compound revealed coexisting stage 1 phases with significantly different values for the c-axis spacing between carbon layers (10.24 A and 10.83 A). For the stage 2 compound, neutron diffraction and electron diffraction studies report a 2x2 in-plane superlattice. No diffraction peaks associated with coherent stacking of the intercalate layers have been reported. In this paper the authors reexamine the layer structure of the stage 1,2 compounds on the basis of recent (00iota) neutron diffraction data. Previous (00iota) x-ray data on stage 1,2 have been interpreted to indicate that the KHg intercalant is organized into layers: two K layers in epitaxy with the carbon layers and two centrally located, but split Hg layers. In particular, the authors discuss the observed difference in the Hg c-axis organization for the majority and minority phases of stage 1 graphite-KHg.

34006 Pressure-induced staging transitions in potassium-graphite intercalation compounds. Kim, H.J. (Univ. of Pennsylvania, PA (US)); Fischer, J.E.; Axe, J.D.; McWhan, D.B. v.v of Graphite intercalation compounds. Eklund, P.C.; Dresselhaus, M.S.; Dresselhaus, G. Materials Research Society, Pittsburgh, PA (1984). (CONF-841157–: Materials Research Society annual meeting, Boston, Massachusetts, USA, 26-29 Nov 1984).

In this paper the authors describe detailed measurements of pressure dependent (00iota) neutron diffractograms for several samples of nominally stage 2 and 3 potassium-graphite compounds. Several new features are observed which suggest a more complex relation between inter- and intralayer coupling than that deduced from earlier experiments. One sample of each stage was pure at ambient pressure, with C/L ratios 27.3 $\pm$ 1.0 and 36.2 $\pm$ 1.5 respectively, determined from weight uptake. The purity of initial staging had no qualitative effect on the pressure response. The pressure medium was 1:1 mixture of pentane/isopentane, and for the most recent experiments the authors included a piece of HOPG in the cell for accurate pressure determination via the compressibility of pure graphite.

34007 The thermal conductivity of pristine and intercalated benzene-derived carbon fibers. Piraux, L. (Univ. of Louvain (BE)); Nystem, B.; Issi, J.P.; Endo, M.; Salamanca-Riba, L.; Dresselhaus,

M.S. v.v of Graphite intercalation compounds. Eklund, P.C.; Dresselhaus, M.S.; Dresselhaus, G. Materials Research Society, Pittsburgh, PA (1984). (CONF-841157–: Materials Research Society annual meeting, Boston, Massachusetts, USA, 26-29 Nov 1984).

In contrast to HOPG, it is possible to measure simultaneously the DC electrical resistivity and the thermal conductivity on intercalated benzene-derived fibers (BDF). This facilitates to a great extent the separation of the lattice K_l and the electronic K_e components of the total thermal conductivity. Starting from electrical resistivity data taken on both pristine and acceptor-intercalated fibers and using the Wiedemann-Franz law, the temperature dependence of the electronic thermal conductivity is computed. By comparing the electronic thermal conductivity K_e with the measured total thermal conductivity K, the effect of intercalation on the lattice thermal conductivity is determined. Results are compared with those previously obtained on HOPG intercalated with the same species and to the same stage.

34008 Deposition of thick, adherent copper coatings on glass. Cowden, W.C. (Univ. of California, Lawrence Livermore National Lab., P.O. Box 808, Livermore, CA (US)); Beat, T.G.; Wash, T.A.; Dini, J.W. v.v of Proceedings of the Electrochemical Society fall meeting. Volume 88-2 (extended abstracts). The Electrochemical Society, Pennington, NJ (1988). (CONF-881061–: Electrochemical Society fall meeting, Chicago, Illinois, USA, 9-14 Oct 1988).

Thick (1 mm), adherent copper was needed on low coefficient of expansion glass to serve as a heat sink for a laser calorimeter. Also, adherent, diamond-turnable coatings on glass approximately 75 μm thick were sought for possible improvements in the optics of systems currently fabricated from metal. To meet these requirements, vacuum deposition and electroplating were combined. An initial adherent, thin layer was deposited by magnetron sputtering and then thick copper was built-up by electroplating. This combined usage of these two different coating processes is but one example of applications wherein these technologies can complement one another. The conventional technology used by platers for metallizing non-conductors via stannous chloride/palladium chloride activation followed by electroless deposition prior to final electroplating is not acceptable for glass when thick coatings are required. With this process, deposits thicker than around 12.5 μm (0.5 mil) easily separate from the glass substrate.

34009 Photoconductor pulse generators and sampling gates for characterization of high-speed devices and transmission lines. Paulter, N.G. (Electronics Research Group, Los Alamos National Lab., Mail Stop D-429, Los Alamos, NM (US)); Hammond, R.B. v.v of Characterization of very high speed semiconductor devices and integrated circuits. Jain, R. SPIE Society of Photo-Optical Instrumentation Engineers, Bellingham, WA (1987). (CONF-8703251–: Characterization of very high speed semiconductor devices and integrated circuits, Bay Point, Florida, USA, 23-25 Mar 1987).

The authors describe photoconductive semiconductor devices developed for application in diagnostics of high-speed electronic devices and circuits. Both pulse generation and sampling functions are provided by these ultrafast photoconductors. The photoresponse of different semiconductor materials (GaAs, InP, Si) that have been ion bombarded (Ar, H, He, Ne, O, Si) was investigated and characterized. Response times as short as 1 picosecond have been observed. High frequency propagation characteristics of microstrip and coplanar waveguide transmission lines have been studied and modelled. Application of this measurement technique to the characterization of a microwave GaAs transistor is presented.

34010 Density and packing in uranium based metallic glasses. Drehman, A.J. (Ames Lab.-USDOE, Iowa State Univ., Ames, IA (US)). v.v of Phase transitions in condensed systems - experiments and theory. Cargill, G.S. III; Spaepen, F.; Tu, K.N. Materials Research Society, Pittsburgh, PA (1987). (CONF-851260–: Symposium on phase transitions in condensed systems: experiments and theory, Boston, Massachusetts, USA, 2-7 Dec 1985).

Density and x-ray diffraction measurements were performed over a wide compositional range of U-Fe and U-Co metallic glass ribbons. The compositional dependence of both the density and the average nearest neighbor distance exhibits a change in slope at approximately 28 at.% transition metal. This suggests an ideal glass composition possessing a minimum excess volume. A qualitative model of atomic packing is proposed, which is based on the compositional dependence of the atomic volume and nearest neighbor distance.

34011 Effects of thermal donor generation and annihilation upon oxygen precipitation. Hahn, S. (Siltec Corp., Mountain View, CA (US)); Shatas, S.; Stein, H.J. v.v of Oxygen, carbon, hydrogen and nitrogen in crystalline silicon. Mikkelsen, J.C.; Pearton, S.J.; Corbett, J.W.; Pennycook, S.J. Materials Research Society, Pittsburgh, PA (1986). (CONF-8512141–: Oxygen, carbon, hydrogen and nitrogen in crystalline silicon, Boston, Massachusetts, USA, 2-5 Dec 1985).

Rapid thermal annealing and furnace annealing steps have been combined to investigate the effects of thermal donor generation and annihilation upon oxygen precipitation in low and high carbon content silicon wafers. Thermal donors were formed by furnace annealing at 450^{0}C. Rapid thermal annealing was performed in 10 s periods at temperatures between 600^0 and 1000^{0}C and was followed by two step furnace annealing at 700^0 and 950^{0}C. Rapid thermal annealing separates the annealing stage for thermal donor removal from that for removal of oxygen precipitate nuclei, and a marked dependence upon carbon is observed for nuclei stability under RTA. Implications of these observations for models of precipitate nuclei are considered.

34012 High resolution electron microscopy studies of potassium-hydrogen intercalated graphite. Salamanca-Riba, L. (Massachusetts Institute of Technology, Cambridge, MA (US)); Yeh, N.C.; Enoki, T.; Dresselhaus, M.S.; Endo, M.; Dresselhaus, G. v.v of Graphite intercalation compounds. Eklund, P.C.; Dresselhaus, M.S.; Dresselhaus, G. Materials Research Society, Pittsburgh, PA (1984). (CONF-841157–: Materials Research Society annual meeting, Boston, Massachusetts, USA, 26-29 Nov 1984).

Synthesis of the KH_x-GIC's can be achieved by direct intercalation of KH or by chemical absorption of hydrogen into potassium-GIC. However, stage 1 KH_x - GIC can only be obtained by the direct intercalation of KH. The stoichiometry of the compound depends on the intercalation process, with a higher hydrogen uptake for the direct intercalation of KH ($x - 0.8$) than for the chemical absorption of hydrogen into potassium-GIC ($x - 0.66$). In this work the authors use high resolution transmission electron microscopy (TEM) to study and compare the structure of KH_x-GIC obtained by the two intercalation methods. The authors have used both highly oriented pyrolytic graphite (HOPG) and benzene-derived graphite fibers (BDGF) as host materials. The HOPG based samples give information about the in-plane structure, whereas the fiber host provides information about the c-axis structure. During the TEM observation, electron beam induced desorption of the hydrogen takes place, thereby allowing detailed examination of the desorption process.

34013 Raman characterization of potassium-hydrogen intercalated graphite. Yeh, N.C. (Massachusetts Institute of Technology, Cambridge, MA (US)); Enoki, T.; McNeil, L.E.; Roth, G.; Salamanca-Riba, L.; Endo, M.; Dresselhaus, G. v.v of Graphite intercalation compounds. Eklund, P.C.; Dresselhaus, M.S.; Dresselhaus, G. Materials Research Society, Pittsburgh, PA (1984). (CONF-841157–: Materials Research Society annual meeting, Boston, Massachusetts, USA, 26-29 Nov 1984).

The strong electron affinity of hydrogen atoms in the ternary potassium-hydrogen-GICs (i.e., compounds $C_{4n}KH_x$ ($n \geq 1$ and $0 < x \leq 1$) decreases the charge transfer from the potassium to the carbon layers, relative to C_8K. This gives rise to very different electronic properties from the alkali-metal GICs. The properties of $C_{4n}KH_x$ also depend on the amount of hydrogen uptake, but are generally similar to those of $C_{4n}KHg_x$, which is isostructural to the hydrogen compounds. In this work, studies of the structure and the homogeneity of KH-GICs, obtained under different preparation conditions, are reported. Using the Raman microprobe the stage number of single fibers can be determined by evaluating the Raman shift. With the Raman microprobe, spectra can be taken of various regions (typically – 2μm diameter) of intercalated HOPG and kish samples, thus allowing a survey of the homogeneity of the intercalated sample. In addition, staging of the samples was determined using x-ray diffraction, and the intercalate layer structure was studied using TEM measurements made on some of the same samples.

It is found that both the in-plane structure and the c-axis repeat distance vary as a function of preparation temperature.

34014 Various stress measurement techniques for thin metal films on plastics. Thomas, N.L. (Lawrence Livermore National Lab., P.O. Box 808, Livermore, CA (US)). v.v of Proceedings of the Electrochemical Society fall meeting. Volume 88-2 (extended abstracts). The Electrochemical Society, Pennington, NJ (1988). (CONF-881061–: Electrochemical Society fall meeting, Chicago, Illinois, USA, 9-14 Oct 1988).

Thin film stress can play an important part in the fabrication of thin metal films on plastic substrates, and can cause unwanted deformations and failure. The stress parameter has been shown to be adjustable by varying the deposition parameters during thermal evaporation or sputtering. For example, ion assisted reactive evaporation is a deposition technique which has been shown to be useful in controlling stress, in addition to other thin film parameters. The successful application of these techniques requires that the stress be monitored, in-situ, curing a coating run, or, by means of a piggy-backed stress monitor disk whose curvature is measured after the coating run. Thin film stress is caused by lattice strain caused by the manner in which the film condenses, and by differential thermal contraction for the film and substrate during cooling. These stress contributions are known as the intrinsic and thermal parts. X-ray diffraction and Raman techniques are used to determine the lattice, strain, directly. The other techniques measure the bending of a disk or rectangular beam by optical methods. Some data are presented on thin film stress versus deposition parameters in order to illustrate how one can control thin film stress by adjusting those parameters.

34015 Thermal response of charge decay in silicon oxynitride films. Miller, S.L. (Sandia National Labs., Albuquerque, NM (US)); Dellin, T.A. v.v of Proceedings of the Electrochemical Society fall meeting. Volume 88-2 (extended abstracts). The Electrochemical Society, Pennington, NJ (1988). (CONF-881061–: Electrochemical Society fall meeting, Chicago, Illinois, USA, 9-14 Oct 1988).

Silicon Nitride Oxide Silicon (SNOS) nonvolatile memories are experiencing an increased use in commercial and weapon/space applications. Improving data retention in SNOS transistors is important in both of these application areas. For commercial applications, improving retention makes it easier to scale down the transistor dimensions to those required in higher density EEPROMs. For weapon/space applications, improving retention allows EEPRTOMs to operate in radiation and extended thermal environments. The data retention of SNOS transistors is determined by the charge trapping and transport properties of the insulating films. The data retention can be improved by optimizing the composition and/or geometry of the memory stack dielectrics. The purpose of the present paper is to describe the improvement in the data retention that results from substituting silicon oxynitride for silicon nitride in SNOS transistors.

34016 Issues on silicon oxynitride films. Stein, H.J. (Sandia National Labs., Albuquerque, NM (US)). v.v of Proceedings of the Electrochemical Society fall meeting. Volume 88-2 (extended abstracts). The Electrochemical Society, Pennington, NJ (1988). (CONF-881061–: Electrochemical Society fall meeting, Chicago, Illinois, USA, 9-14 Oct 1988).

There is an increasing interest in thin amorphous oxynitride films for dielectrics in microelectronics. Compositions for these films can be varied continuously from Si_3N_4 to SiO_2 including Si_2N_2O of crystalline oxynitride. New methods of film growth and processing have been introduced in response to the expanded interests. For example, ion implantation of combinations of O and N has been explored as a method for producing a buried dielectric layer in Si. Nitrided thin oxide films and oxidized thin nitride films on Si are new thrusts toward engineering of thin dielectric layers for specific applications. Chemical vapor deposition (CVD) and plasma (or photo) enhanced CVD continue to be improved and remain the primary methods for oxynitride film growth. There are several interrelated issues on oxynitride films: 1) growth processes, 2) composition and structure, 3) stability and reconstruction, 4) impurity diffusion, 5) charge trapping and transport, 6) band structure, and 7) electronic levels.

34017 First time formation of continuous amorphous layers with boron at room temperature. Raicu, B. (Materials Research Div., Lawrence Berkeley Lab., Berkeley, CA (US)); Shih, Y. v.v of Proceedings of the 1987 Electrochemical Society spring meeting: Extended abstracts. Volume 87-1. The Electrochemical Society, Pennington, NJ (1987). (CONF-870560–: 171. Electrochemical Society meeting, Philadelphia, Pennsylvania, USA, 10-15 May 1987).

Formation of shallow p^+ functions in silicon by boron ion implantation is a challenging research subject. Many research reports have concluded that amorphization with boron at room temperature is not possible and that only irradiations at liquid nitrogen temperature maintain the amorphicity. High electrical efficiency and minimal residual defect formation during solid phase regrowth are achieved if the implanted layer is perfectly amorphous. The limiting factors were insufficient heat transfer and low dose rates. A source and drain process was set up with a beam power density of 240-w/cm^2 (E = 35 KeV, 0 = 5E15 i/cm^2). Special scanning conditions and forced cooling have been used. The measured wafer temperature did not exceed 35^{0}C. (a process patent is pending). This paper reviews the available models describing structural change during amorphization with boron at room temperature, the applications of the new process to VLSI/ULSI, and the state of the art implantation equipment capable to implement the process in a production environment.

34018 The melting of amorphous Si. Poate, J.M. (AT and T Bell Labs., Murray Hill, NJ (US)); Peercy, P.S.; Thompson, M.O. v.v of Phase transitions in condensed systems - experiments and theory. Cargill, G.S. III; Spaepen, F.; Tu, K.N. Materials Research Society, Pittsburgh, PA (1987). (CONF-851260–: Symposium on phase transitions in condensed systems: experiments and theory, Boston, Massachusetts, USA, 2-7 Dec 1985).

The prediction that amorphous Si and Ge undergo first order melting transitions at temperature T_{aiota} substantially beneath the crystalline melting temperature T_{ciota} has stimulated much work. Structural, calorimetric and transient conductance measurements show that, for Si, $T_{ciota} - T_{aiota}$ lies in the range of 225-250^{0}K. Studies of the pulsed laser melting of the Si amorphous-liquid transition have resulted in the following findings, an estimate of the undercooling rate of 15^{0}K/m/sec, and understanding of the mechanism mediating explosive crystallization, the formation of internal melts and segregation of dopants at the liquid-amorphous interface.

34019 Velocity and orientation dependence of solute trapping. Aziz, M.J. (Solid State Div., Oak Ridge National Lab., Oak Ridge, TN (US)); White, C.W.; Tsao, J.Y.; Peercy, P.S.; Thompson, M.O. v.v of Phase transitions in condensed systems - experiments and theory. Cargill, G.S. III; Spaepen, F.; Tu, K.N. Materials Research Society, Pittsburgh, PA (1987). (CONF-851260–: Symposium on phase transitions in condensed systems: experiments and theory, Boston, Massachusetts, USA, 2-7 Dec 1985).

The fraction of impurity atoms in the liquid at the solid-liquid interface that join the crystal, known as the segregation coefficient k, during rapid crystal growth is known to deviate away from the equilibrium value towards unity as the interface speed v increases. Several plausible models have been proposed that account qualitatively for this behavior with different functional forms of k(v). The authors report measurements of the segregation behavior during rapid solidification following pulsed laser melting of Bi-implanted Si. The velocity dependence and the orientation dependence of the segregation coefficient of Bi in Si has been determined to sufficient accuracy to allow the authors to distinguish between models. Implications for the mechanism of solute trapping are discussed.

34020 Off-center N and O in silicon. Hjalmarson, H.P. (Sandia National Labs., Albuquerque, NM (US)); Jennison, D.R.; Binkley, J.S. v.v of Oxygen, carbon, hydrogen and nitrogen in crystalline silicon. Mikkelsen, J.C.; Pearton, S.J.; Corbett, J.W.; Pennycook, S.J. Materials Research Society, Pittsburgh, PA (1986). (CONF-8512141–: Oxygen, carbon, hydrogen and nitrogen in crystalline silicon, Boston, Massachusetts, USA, 2-5 Dec 1985).

The pseudo Jahn-Teller effect and chemical rebonding are both considered as mechanisms that drive substitutional atoms, such as N in Si, off-center. By use of an effective Hamiltonian technique, impurities forming very deep levels, such as Si:N, are found to be susceptible to off-center displacement by the pseudo Jan-Teller effect. Using a Hartree-Fock technique, the authors find two classes of N displacements which depend on the relaxation of the nearest-neighbor Si atom cage. For outward relaxation of the four nearest neighbors, the N displaces by 0.05 A in the direction and retains

sp^3 bonding; this mechanism appears equivalent to the pseudo Jahn-Teller effect. For inward relaxation of the cage by 0.45 A, the N displaces by 0.75 A in the direction and forms a trigonal sp^2 bond; this is a chemical rebonding mechanism. Additional cluster calculations suggest that inward relaxation of the cage is likely. Similar calculations for 0 revealed a <100> displacement of approximately 1.1A.

34021 Variations in the refractive index of the near-surface region of low energy hydrogen ion bombarded silicon. Pettit, R.B. (Sandia National Labs., Albuquerque, NM (US)); Panitz, J.K.G. v.v of Oxygen, carbon, hydrogen and nitrogen in crystalline silicon. Mikkelsen, J.C.; Pearton, S.J.; Corbett, J.W.; Pennycook, S.J. Materials Research Society, Pittsburgh, PA (1986). (CONF-8512141–: Oxygen, carbon, hydrogen and nitrogen in crystalline silicon, Boston, Massachusetts, USA, 2-5 Dec 1985).

Using ellipsometric analysis, the complex index of refraction of low-energy, hydrogen ion bombarded, [100] single-crystal silicon was measured as a function of distance from the bombarded surface. The bombardment conditions were a 1600 eV hydrogen beam produced by a Kaufman ion source, 1.4 mA/cm^2 flux, 2 x 10^{18} ions/cm^2 fluence and 275^{0}C bulk silicon temperature. These conditions are comparable to the conditions generally reported to result in a substantial increase in the electrical conductivity of polycrystalline silicon solar cell material. The results of this study indicate that the real and imaginary parts of the refractive index of the ion bombarded surface region approach that of the unbombarded substrate at a depth of 50 nm. The refractive index of about the first 10 nm of ion bombarded material is strongly dependent on the bombardment conditions. Variations in the imaginary part of the refractive index indicate that approximately 10% of incident radiation is absorbed by the first 50 nm of modified material.

34022 Secondary neutral mass spectrometry. Pellin, M.J. (Argonne National Lab., Materials Science and Chemistry Divs., Argonne, IL (US)); Young, C.E.; Calaway, W.F.; Burnett, J.W.; Gruen, D.M. v.v of Proceedings of the Electrochemical Society fall meeting. Volume 88-2 (extended abstracts). The Electrochemical Society, Pennington, NJ (1988). (CONF-881061–: Electrochemical Society fall meeting, Chicago, Illinois, USA, 9-14 Oct 1988).

Recently, significant research activity has been directed at the technique of Secondary Neutral Mass Spectrometry (SNMS). This technique utilizes the secondary neutral sputtered fraction for analysis. SNMS under certain conditions can provide dramatic increases in both useful yield and quantitative analysis. These increases are the direct result of the proclivity of the sputtering process to produce ground state neutral atoms rather than ions. The detection of the major sputtering products allows for substantially higher useful yields. This paper centers on the use of lasers to ionize and then detect the sputtered neutral particles. This paper emphasizes resonant laser ionization since trace surface analysis requires the enchanced discrimination and useful yield which this technique provides. Indeed, the removal of isobaric overlaps at the 500 ppt level has already demonstrated the inherent discrimination which resonance ionization spectroscopy laser ionization SNMS provides. Furthermore, demonstrated sensitivity at the $\simeq$100 ppt level with a noise equivalent level of >30 ppt indicates the power of these measurements. This is not to imply that this method is the optimal choice for all analysis. Each technique has a particular set of advantages and disadvantages meaning that the technique of choice must be matched to the problem of interest.

34023 A structural investigation of compositionally graded $InAs_{1-x}Sb_x$ buffer layers. Biefeld, R.M. (Sandia National Labs., Div. 1144, Albuquerque, NM (US)). v.v of Proceedings of the Electrochemical Society fall meeting. Volume 88-2 (extended abstracts). The Electrochemical Society, Pennington, NJ (1988). (CONF-881061–: Electrochemical Society fall meeting, Chicago, Illinois, USA, 9-14 Oct 1988).

The structures prepared in this work consisted of the InSb substrate, an initial InSb epitaxial layer, a buffer layer and an uppermost superlattice. The buffer layers were of four types: 1) a constant composition layer; 2) a step-graded layer consisting of three or five equal thickness, constant composition layers; 3) a continuously graded layer where x increased exponentially with layer thickness and 4) a continuously graded layer in which x increased linearly with layer thickness. The compositions were determined from double-crystal x-ay rocking curves using the (004) and (115) reflections. The strain distribution and layer thickness of both the buffer layers and the SLS's were obtained using a kinematical model as previously described. The surface morphologies were examined by Nomarski interference contrast microscopy. The distribution of dislocations in the buffer layers was investigated by transmission electron microscopy. The surface morphologies of the samples grown on thick, continuously graded buffer layers showed the presence of the normal cross hatching which is typical of mismatched layers which contain dislocations. However, the surfaces which contained thin buffers or buffers with abrupt compositional steps indicated the presence of microcracks. When a critical layer thickness was exceeded for a particular mismatch, microcracks formed in the samples. The thicker, continuously graded buffer layers apparently allow enough dislocations to form during the layer growth so that the critical layer thickness for crack formation is never exceeded. In contrast, not enough dislocations are formed in the thinner layers to prevent the critical layer thickness for crack formation from being exceeded.

34024 In situ characterization of heteroepitaxy by quasi-elastic light scattering. Olson, J.M. (Solar Energy Research Institute, Golden, CO (US)). v.v of Proceedings of the Electrochemical Society fall meeting. Volume 88-2 (extended abstracts). The Electrochemical Society, Pennington, NJ (1988). (CONF-881061–: Electrochemical Society fall meeting, Chicago, Illinois, USA, 9-14 Oct 1988).

Lattice mismatched heteroepitaxial structures including strained-layer superlattices (SLSs) of semiconducting materials are currently of considerable interest in the electronics community. It is now generally accepted, however, that SLSs with arbitrarily large interlayer strain and thicknesses and perfect planar morphology are difficult, if not impossible, to grow. Using quasi-elastic light scattering, we show that this is a consequence of the intrinsic, thermodynamic tendency of strained epitaxial films to grow with a three-dimensional morphology. Most of the experimental insight into this problem has been gleaned from work on the growth of SLSs using MBE and the host of in situ analytical equipment typically found on most MBE machines. The situation for MOCVD-grown SLSs is considerably less advanced due, in large part, to the lack of in situ growth monitoring techniques. With this in mind, the authors have developed a simple apparatus for measuring the quasi-elastic light scattering (QLS) from the surface of a growing epilayer. The QLS measurement is sensitive to the roughness or three-dimensional (3-D) morphology of the growing surfaces. Light from a 15 mW HeNe laser is directed approximately normal to the surface of the growing crystal through a quartz window. The window is effectively cooled by the incoming source gases and consequently remains transparent for the duration of the experiment.

34025 Charge transfer luminescence in polysilanes. Thorne, J.R.G. (Univ. of Pennsylvania, Dept. of Chemistry, 231 S. 34th Street, Philadelphia, PA (US)); Hochstrasser, R.M.; Zeigler, J.M. v.v of Proceedings of the Electrochemical Society fall meeting. Volume 88-2 (extended abstracts). The Electrochemical Society, Pennington, NJ (1988). (CONF-881061–: Electrochemical Society fall meeting, Chicago, Illinois, USA, 9-14 Oct 1988).

There is interest in a new class of saturated long-chain silicon polymers $(R_1R_2Si)_n$, where R_1,R_2 represent alkyl or aryl groups. The importance of the polysilanes stems mostly from their potential as photoresists but the nature of the optical excitations is still in debate. The authors concentrate here upon the emissive properties of the materials and attempt a rationalization of experimental observations. Both alkyl and aryl substituted materials, in solution and in thin films, have a single sharp fluorescence at –350 nm, coincident at low temperature with the first absorption maximum. The polarization of this band has led to the conclusion that it is associated with a $\sigma\sigma$ transition of the silicon backbone. In addition, in the aryl-substituted compound, $(PhMeSi)_n$, a very broad emission is present at 430 nm, whose intensity increases dramatically on cooling such that it dominates the spectrum at 4 K. This band is thought to arise from a charge transfer state, by analogy with the luminescence from phenyldisilanes and phenylethynyldisilanes. The direction of charge

transfer, from silicon to phenyl, would create a separated electron-hole pair and might account for the observed hole photoconductivity of polysilanes. The authors have measured luminescence lifetimes for these dual emissions in solution, glass, thin film and powder. The natural radiative lifetime for 350 nm emission is found to be ~600 picoseconds, which exceeds that predicted from the absorption oscillator strength per silicon atom, and implies a delocalization of the $\sigma\sigma$ excitation over perhaps twenty sites on the silicon chain. Our fluorescence depolarization measurements indeed show the excitation to be extremely mobile. In some of these materials the observed fluorescence lifetime is shorter than this value.

34026 Fiber ring resonators and shock excited mechanical oscillators. Butler, M.A. (Microsensor Div., 1113, Sandia National Labs., Albuquerque, NM (US)). v.v of Proceedings of the Electrochemical Society fall meeting. Volume 88-2 (extended abstracts). The Electrochemical Society, Pennington, NJ (1988). (CONF-881061–: Electrochemical Society fall meeting, Chicago, Illinois, USA, 9-14 Oct 1988).

A fiber ring resonator is a single mode, optical fiber loop into and out of which light can be coupled. This structure behaves as an interferometer in that the intensity of light out varies cyclically with the length of the loop where the period is the wavelength of the light. Such a structure can be made into a sensor if the quantity to be sensed can be made to modify the length of the fiber loop. This can be done by heating the fiber or straining it. Heat transfer to the fiber core is a relatively slow process, so the authors will consider strain effects. To measure energy impulses the fiber must have a suitable coating so that the energy heats the coating and thus produces thermal strains which will propagate to the fiber core. To test this concept the system shown in figure 1 was assembled to measure the energy in current pulses. Other forms of energy would require other coatings. A current pulse in the 5-10 microsecond range is sent to the thin CuNi tube and heats the tube. The tube will expand and the strains will be applied to the fiber since the fiber is bonded to the ends of the tube. As the fiber is stretched a string of optical pulses is observed at the output with the number of pulses proportional to the energy in the pulse.

34027 Chemisorption-induced reflectivity changes in thin metal films. Ricco, A.J. (Sandia National Labs., Albuquerque, NM (US)); Butler, M.A. v.v of Proceedings of the Electrochemical Society fall meeting. Volume 88-2 (extended abstracts). The Electrochemical Society, Pennington, NJ (1988). (CONF-881061–: Electrochemical Society fall meeting, Chicago, Illinois, USA, 9-14 Oct 1988).

Chemisorption changes the reflectivity of a metal surface. For optically thin metal films, the chemisorption process can change the effective optical thickness of the film, and therefore its reflectivity, by a relatively large fraction. Typical results of an experiment are shown for a 100 A thick silver film exposed to 100 ppm of H_2 S in N_2 at 1 atmosphere. This concentration represents 65,000 Langmuirs of exposure per second and thus the magnitudes of the measured shifts are not dependent on the time of exposure to the gas. A step reduction in the reflectivity of about 1% occurs in a few seconds (the time require to fill the bell jar) upon exposure of the silvered fiber end. Over a much longer time period, there is a slow decrease of the reflectivity to or below the level observed for the bare fiber. The authors attribute the initial step to chemisorption-induced changes in the reflectivity of the thin film, and the much slower drop in reflectivity to a bulk chemical reaction forming Ag_2S. Although many molecule/metal combinations fail to produce a bulk reaction at 25C, the initial chemisorption step is common to all the adsorbates the authors examined and is more likely to be reversible; it was therefore chosen for detailed study. Exposure of freshly evaporated, 100 A thick Ag films resulted in initial step changes in reflectivity for H_2S, CO, O_2, SO_2, and H_2 of -0.7%, -0.6%, -0.5%, -0.45%, and -0.1%, respectively. Measurements were also attempted on NO_2 and Cl_2, but these molecules showed large, rapid changes due to irreversible bulk chemical reactions, so a clear step could not be defined.

34028 Photoelectrochemical characterization of defect heterogeneities in anodic TiO_2 films. Kozlowski, M.R. (Corrosion Research Center and Dept. of Chemical Engineering and Materials Science, Univ. of Minnesota, Minneapolis, MN (US)); Paik, C.H.; Tyler, P.S.; Smyrl, W.H.; Atanasoki, R.T. v.v of Proceedings of the Electrochemical Society fall meeting. Volume 88-2 (extended abstracts). The Electrochemical Society, Pennington, NJ (1988). (CONF-881061–: Electrochemical Society fall meeting, Chicago, Illinois, USA, 9-14 Oct 1988).

An understanding of the local properties of thin semiconducting oxide films is important in the areas of microelectronics, corrosion, catalysis, and solar energy conversion. The authors report the results of a study of the local photoelectrochemical and structural properties of thin (<20 nm). TiO_2 films grown by anodic polarization of polycrystalline titanium substrates. The principal technique used in the investigation was photoelectrochemical microscopy (PEM). PEM is a quantitative in-situ technique which utilizes a focused laser beam to measure local photocurrents in semiconducting films. The photoelectrochemical properties of thin anodic TiO_2 films grown on polycrystalline titanium substrates have been shown to be heterogeneous and dependent on the oxide growth rate and the crystallography of the underlying titanium substrate. By combining PEM data with that of structural studies and local metal photodeposition studies on these same films, a model is evolved which attributes the heterogeneous photoelectrochemical properties of the oxide to variations in the oxide defect structure. For oxides grown slowly (~1 nm/h), by ramping the potential of the metal substrate at 0.1 mV/s, the oxide photoresponse was found to map the grain structure of the underlying titanium substrate. As the oxide growth rate was increased the photoresponse became more homogeneous and the average photocurrent decreased.

34029 Solid state electrochromic windows. Rauh, R.D. (EIC Labs., Inc., Norwood, MA (US)). v.v of Proceedings of the Electrochemical Society fall meeting. Volume 88-2 (extended abstracts). The Electrochemical Society, Pennington, NJ (1988). (CONF-881061–: Electrochemical Society fall meeting, Chicago, Illinois, USA, 9-14 Oct 1988).

The last several years has seen a resurgence in interests in electrochromism, not for displays, but for variable transmittance windows. Electrochromic smart windows hold the prospect for adjustable light transmittance induced by a low voltage dc electrical current. The basic structure is that of a thin film secondary battery with a visible state of charge. As such, the window is comprised of three types of thin film materials: 1) transparent electrical conductors, which act as current collectors: 2) mixed conductors, which form the electroactive, color changing elements; and 3) ion conductors, which form the electrolyte while being electronically insulating. Interestingly, numerous electrochromic light modulators in the literature are lacking one or more of these fundamental components, resulting in either poor long term reversibility and disruption of electrode components, short open circuit memory arising from chemical or electronic self-discharge, or both. Currently, there are two basic approaches to window construction. One is to deposit the electrical conductor and electrochromic electrodes separately on two pieces of glass, then to laminate them together with a semisolid or polymeric electrolyte. The second is to produce a multilayer thin film stack by sequential sputtering of the layers. The principle difference between the two approaches lies in the electrolyte. Materials development for electrochromic windows has been concerned mostly with the electrochromic and electrolyte layers. The primary electrochromic material being considered is still WO_3, since it combines robustness with long-term cyclability, as demonstrated repeatedly in the display literature.

34030 Photoelectrochemistry at n-type semiconductors protected by metallized plasma coatings. Schwerzel, R.E. (Battelle, Columbus Div., 505 King Avenue, Columbus, OH (US)); Behrer, P.C.; Sliemers, F.A.; Spahr, K.B. v.v of Proceedings of the Electrochemical Society Fall meeting: Extended abstracts. Volume 87-2. The Electrochemical Society, Pennington, NJ (1987). (CONF-871027–: 172. meeting of the Electrochemical Society, Honolulu, Hawaii, USA, 18-23 Oct 1987).

Recent work in the authors' laboratories has demonstrated that metallized plasma polymer coatings deposited by rf plasma sputtering techniques can substantially improve the stability of n-type semiconductor photoanodes in aqueous solution. These coatings, which are typically composed of co-sputtered gold and polyethylene, can be made to be hydrophobic, electrically conductive, and reasonably transparent. With about 40 to 50 atom percent gold, the

films have sheet resistance of 10-30 ohms/square and transmittance in excess of 60 percent throughout the visible, near-IR, and near-UV wavelengths. These coatings dramatically alter the nature of the photoanode surface, however, and therefore should have a significant effect on the relative rates of competitive reactions, such as the photo-Kolbe reaction, that depend heavily on the presence of adsorbed species at the electrode surface. In particular, the relative yields of products from the photo-Kolbe reaction should be highly sensitive to this type of electrode surface modification. This paper describes the behavior of semiconductor photoanodes protected by metallized plasma polymer coatings, with emphasis on the photo-Kolbe reaction, and examines the role of surface modification in controlling the relative rates of competing interfacial electron-transfer reactions.

34031 Junction effects in conductive polymer-modified CdS electrodes. Frank, A.J. (Solar Energy Research Institute, 1617 Cole Boulevard, Golden, CO (US)); Glenis, S. v.v of Proceedings of the Electrochemical Society Fall meeting: Extended abstracts. Volume 87-2. The Electrochemical Society, Pennington, NJ (1987). (CONF-871027--: 172. meeting of the Electrochemical Society, Honolulu, Hawaii, USA, 18-23 Oct 1987).

The work function phi is a critical parameter for characterizing the metallic or semiconductor nature of the plymer. This parameter plays a crucial role in determining the charge-transfer efficiency in conductive polymer-modified semiconductor electrodes. Difference in work functions between two materials in intimate electronic contact give rise to junction (or barrier) effects. Recently, the authors have characterized the junctions that are formed when poly (3-methylthiopene) (PMeT) contacts a semiconductor, a metal, or a redox electrolyte. In the solid state, have found, for example, that an ohmic contact is formed between PMeT and gold. In other words, the voltage drop across the metal-polymer junction is small compared to the voltage drop across the active region of the polymer. In contract, a 0.9 V Scnottky barrier, as determined from analyses of I-V and C-V measurements, is formed at the CdS-(PF_6^--doped) PMeT junction with a rectification ratio of 10^5 at 0.8 V. Based on a thermoionic emission model, the diode ideality factor is 1.7, which deviates considerably from the theoretical prediction of 1 for a well-behaved conventional semiconductor. The deviation of the ideality factor from 1 indicates extensive charge recombination in the depletion region of the CdS-PMeT interfaces.

34032 CVD tungsten for buried layer conductors. Blewer, R.S. (Center for Radiation Hardened Microelectronics, Sandia National Lab., Albuquerque, NM (US)); Tsao, S.S.; Tracy, M.E.; Gutierrez, G. v.v of Proceedings of the Electrochemical Society Fall meeting: Extended abstracts. Volume 87-2. The Electrochemical Society, Pennington, NJ (1987). (CONF-871027--: 172. meeting of the Electrochemical Society, Honolulu, Hawaii, USA, 18-23 Oct 1987).

Chemical vapor deposition (CVD) metallization of the internal surfaces of porous silicon could result in technically interesting device applications if the resistance of the metal path could be made sufficiently low. The authors report on the characteristics of subsurface tungsten conductors deposited by CVD on the internal surfaces of anodically prepared porous silicon. Because the WF-6/Si reduction reaction displaces a greater volume of silicon than is replaced by the resulting metal layer, silicon pores are actually enlarged by the reaction, permitting WF-6 gas to penetrate deeply into the porous structure without blocking the passages. The structure thus forms an attractive test bed for the investigation of diffusion and flow characteristics of refractory metal source gases in a high aspect ratio configuration.

34033 Chemical vapor deposition of B_6P and B_6As films. Aselage, T.L. (Sandia National Labs., Albuquerque, NM (US)). v.v of Proceedings of the Electrochemical Society Fall meeting: Extended abstracts. Volume 87-2. The Electrochemical Society, Pennington, NJ (1987). (CONF-871027--: 172. meeting of the Electrochemical Society, Honolulu, Hawaii, USA, 18-23 Oct 1987).

The objective of this study is to prepare thin films of B_6P and B_6As in pure, stoichiometric, single crystalline form. Purity and stoichiometry are of critical importance in obtaining transparent, high room temperature resistivity material. Carbon concentrations as low as 0.05 w/o can lead to black materials with low, p-type resistivity. Also, the boron phosphide may exist substoichiometrically as a boron-rich phase. This also leads to p-type conductivity. Due to the refractory nature of the materials, preparation of bulk crystals of size suitable for measurement is extremely difficult. Therefore, chemical vapor deposition of thin films provides a convenient and attractive technique for the study and characterization of these materials. In this study, boron phosphide and boron arsenide films are deposited on Si (100) surfaces using the hydrogen reduction of chloride reactants. Chemical vapor deposition has been shown to produce B_6P films on Si that are highly oriented and transparent. The effect of variation in deposition temperature and gas phase concentration in the chloride system on film crystallinity and quality is reported. Electrical properties of the boron phosphide and arsenide films is discussed in terms of the novel application potential.

34034 Quantum architecture of novel semiconductors. Zunger, A. (Solar Energy Research Institute, Golden, CO (US)). v.v of Proceedings of the Electrochemical Society Fall meeting: Extended abstracts. Volume 87-2. The Electrochemical Society, Pennington, NJ (1987). (CONF-871027--: 172. meeting of the Electrochemical Society, Honolulu, Hawaii, USA, 18-23 Oct 1987).

Whereas numerous low technologies have traditionally generated the required diversity of material properties through direct synthesis of a large number of species (e.g., polymer, drug, or bio technologies), the so-called high technology of electronic materials has historically involved only a very limited number of material building block – Si, III-V's and II-VI's. While the electronic technology had nevertheless been able to fine-tune many material properties (e.g., band gaps, lattice parameters) by alloying such building blocks, one nevertheless wonders whether we have not missed altogether some classes of hiterto unknown semiconductors. In this talk the author briefly discusses the way in which modern solid state theory had been used to identify and characterize novel families of semiconductors. The basic tools used involve state-of-the-art methods for solving self-consistently, from first-principles the band structure and total energy problem of real or hypothetical solids, using non-local pseudopotentials, or the mixed basis all-electron approach.

34035 The formation of hexagonal silicon at twin intersections. Dahmen, U. (Materials and Chemical Sciences Div., Lawrence Berkeley Lab., Berkeley, CA (US)); Hetherington, C.J.; Westmacott, K.H.; Pirouz, P. *Scripta Metallurgica (USA)*, 23(2): 269-272 (Feb 1989).

The geometric configuration of intersecting twin bands has been considered in the past in the context of dislocation mechanisms and deformation behavior. It is generally found that a twin band is an effective barrier to the propagation of another, noncoplanar, twin band. However, under conditions of sufficiently high local stress twin intersections are possible, subject to conditions of continuity. The problem of intersecting twins has gained renewed interest with the recent hot-indention experiments in silicon. The deformation microstructure consists of twin bands and planar ribbons of hexagonal Si radiating from the area of the indent. Although at high pressures silicon forms in several different crystal structures, only the diamond-cubic structure is stable at atmospheric pressure. Thus the diamond-hexagonal structure that forms during hot indentation of single crystals is a metastable modification. Recent research established its crystallography by means of high-resolution electron microscopy. In particular, it was shown that the transformation from the diamond-cubic to the diamond-hexagonal structure was of a martensitic nature. It has been postulated that the formation of hexagonal Si in the deformation zone is related to multiple twinning, and a detailed crystallographic model for this transformation has been proposed. The present note reports such an observation by high resolution electron microscopy.

34036 Near-infrared surface-enhanced Raman spectroscopy. Part II: Copper and gold colloids. Angel, S. M. (Environmental Sciences Division, Lawrence Livermore National Laboratory, Livermore, California 94550 (S.M.A., L.F.K.)); Katz, L. F.; Archibald, D. D.; Honigs, D. E. *Applied Spectroscopy (USA)*, 43(3): 367-371 (Mar 1989). DOE Contract W-7405-ENG-48.

Near-infrared (NIR) surface-enhanced Raman spectra (SERS) on copper and gold metal colloids were obtained with a Fourier transform Raman spectrometer using a Nd:YAG laser (1.064 μm) for excitation. Enhanced spectra were observed for pyridine and 3-chloropyridine (CP) on copper colloids and for

tris(orthophenanthroline)ruthenium(II), Ru(o-phen)$^{2+}_3$, on copper and gold colloids. The copper-colloid surface-enhanced Raman spectra of pyridine and CP were compared with spectra measured for these molecules on copper electrodes. NIR-SERS enhancements on the metal colloids were at least as large as for visible-wavelength excited SERS. Good-quality spectra of Ru(o-phen)$^{2+}_3$ were obtained at solution concentrations as low as 0.025 mM.

34037 Structural anomalies in undoped gallium arsenide observed in high-resolution diffraction imaging with monochromatic synchrotron radiation. Steiner, B. (National Institute of Standards and Technology, Gaithersburg, Maryland 20899(US)); Kuriyama, M.; Dobbyn, R. C.; Laor, U.; Larson, D.; Brown, M. *Journal of Applied Physics (USA),* 66(2): 559-568 (15 Jul 1989).

Novel, streaklike disruption features restricted to the plane of diffraction have recently been observed in images obtained by synchrotron radiation diffraction from undoped, semi-insulating gallium arsenide crystals. These features were identified as ensembles of very thin platelets or interfaces lying in {110} planes, and a structural model consisting of antiphase domain boundaries was proposed. We report here the other principal features observed in high resolution monochromatic synchrotron radiation diffraction images: (quasi)cellular structure; linear, very low-angle subgrain boundaries in ⟨110⟩ directions, and surface stripes in a ⟨110⟩ direction. In addition, we report systematic differences in the acceptance angle for images involving various diffraction vectors. When these observations are considered together, a unifying picture emerges. The postulate of thin {110} antiphase boundaries leads to an understanding not only of the streak-like diffraction features but of the other principal features as well. For the formation of such regions we propose two mechanisms, operating in parallel, that appear to be consistent with the mesoscopic structure observed by a variety of techniques.

34038 Mechanism for nearly ohmic behavior in annealed Au/*n*-GaAs Schottky diodes. Leon, R. P. (Department of Materials Science and Mineral Engineering, University of California, and Center for Advanced Materials, Lawrence Berkeley Laboratory, Berkeley, California 94720(US)); Newman, N.; Liliental-Weber, Z.; Weber, E. R.; Washburn, J.; S *Journal of Applied Physics (USA),* 66(2): 711-715 (15 Jul 1989). DOE Contract AC03-76SF00098.

The origin of the ohmic behavior observed after annealing Au/*n*-GaAs {110} Schottky diodes was investigated by electron-beam-induced current (EBIC) measurements of diode plan views and cross sections, combined with standard scanning electron microscopy and transmission electron microscopy techniques. The large leakage currents responsible for this behavior arise at the periphery of the deposited gold films, where elongated gold crystallites which lie on the GaAs surface are observed after heat treatment. These crystallites are typically 2–5 μm long, 500–2000 A wide, and are crystallographically oriented along the GaAs [110] direction. EBIC imaging demonstrated that a space-charge region was present under the peripheral area showing the gold crystallites. Comparison of current collection as measured with EBIC between annealed and unannealed diodes shows a large reduction in current collection under and around the periphery of the annealed diodes. These data allow attribution of the ohmic behavior to a recombination current. Experiments done with overlapping Au evaporations show that recombination on the bare GaAs surface between the observed crystallites surrounding each annealed diode is the main component of this recombination current, and thus of the large leakage current.

34039 Preparation, structure, dynamics, and energetics of amorphous silicon: A molecular-dynamics study. Luedtke, W. D. (School of Physics, Georgia Institute of Technology, Atlanta, Georgia 30332-0430(US)); Landman, U. *Physical Review [Section] B: Condensed Matter (USA),* 40(2): 1164-1174 (15 Jul 1989).

The preparation of amorphous silicon by molecular-dynamics simulationsemploying the Stillinger-Weber Si potential, via direct slow cooling from themelt, is described. It is shown that previous failures to obtain amorphous Siusing these interaction potentials are of kinetic origin, i.e., related to thequench rate employed. The amorphous silicon sample which we prepared exhibitsstructural and dynamical properties in good agreement with availableexperimental data for the static structure factor and phonon density of states.Detailed analyses of the structure, including distributions of bond anddihedral angles and ring statistics, and energetics, including thedetermination of effective temperatures for *n*-fold-coordinated atoms(n=3–5) and estimates of the formation energy of coordinationdefects (i.e., n≠4) are presented. The lack of medium-range order,measured via correlation between dihedral angles associated with adjacentbonds, is discussed.

34040 Excitation profiles of resonance electronic Raman scattering in $ErPO_4$ crystals. Williams, G. M. (Department of Physics, University of California, Berkeley, California 94720(US)); Becker, P. C.; Edelstein, N.; Boatner, L. A.; Abraham, M. M. *Physical Review [Section] B: Condensed Matter (USA),* 40(2): 1288-1296 (15 Jul 1989). DOE Contract AC03-76SF00098.

The intensities of electronic Raman-scattering transitions between theground and excited crystal-field states of the ground$^4I_{15/2}$ multiplet of Er^{3+} incrystals $ErPO_4$ were measured as a function of excitationfrequency in the region of an intermediate-state resonance between the$^4I_{15/2}$ ground state and a crystal-field state ofthe $^4F_{7/2}$ multiplet. It is shown that for excitationfrequencies near the intermediate-state resonance, the observed spectra are theresult of electronic Raman scattering and are not due to absorption followed byfluorescence. No such determination could be made for direct resonanceexcitation. Enhancements of the intensities of the electronic Raman scatteringby a factor on the order of 100 are reported. The electronic Raman-scatteringexcitation profiles (excitation frequency versus enhancement) are found to beasymmetric in excitation frequency about the resonance. These profiles can beaccurately modeled using standard electronic Raman intensity theory and themeasured oscillator strengths and linewidths of the$^4I_{15/2}\rightarrow{}^4F_{7/12}$ one photontransitions.

34041 Negative-*U* property of the *DX* center in $Al_xGa_{1-x}As$:Si. Li, M. F. (Center of Theoretical Physics, Chinese Center of Advanced Science aduate Technology (World Laboratory), 52 Sanlihe Road, Beijing, China(US)); Jia, Y. B.; Yu, P. Y. *Physical Review [Section] B: Condensed Matter (USA),* 40(2): 1430-1433 (15 Jul 1989).

We present two major points in this paper: (1) Statistics derived from thenegative-*U* property of the *DX* center are not consistent withexisting Hall experiments of Si-doped $Al_xGa_{1-x}As$.(2) The discrepancy between the negative-*U* model and Hall experiments canbe improved if there exist two different donors *SD* and *DX* withcomparable concentrations N_{SD} and N_{DX},N_{SD}/N_{DX} increases with increasing N_{Si}.*DX* is a negative-*U* center binding two electrons and *SD* is ashallow donor. *SD* centers provide electrons and the electrons arecaptured by *DX* centers, and therefore the Fermi energy is no longerpinned to the *DX* energy level. Many experiments are reinterpreted in thisview.

34042 Microvoids at the SiO_2/Si interface. Nielsen, B. (Brookhaven National Laboratory, Upton, New York 11973(US)); Lynn, K. G.; Welch, D. O.; Leung, T. C.; Rubloff, G. W. *Physical Review [Section] B: Condensed Matter (USA),* 40(2): 1433-1437 (15 Jul 1989). DOE Contract AC02-76CH00016.

A variable-energy positron beam was used to study device-qualitySiO_2 (≈50-nm thick) grown thermally on the Si(100)surface. The unusual observation of ortho-positronium 3-γ decay at theinterface demonstrates that microvoids >1 nm in size are present,most likely as a consequence of the thermal oxidation process. Otherinterfacial defects were also observed, illustrating the sensitivity ofpositron studies for studying interfacial properties.

34043 Shear waves through the glass-liquid transformation. Grimsditch, M. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439(US)); Bhadra, R.; Torell, L. M. *Physical Review Letters (USA),* 62(22): 2616-2619 (29 May 1989). DOE Contract W-31-109-ENG-38.

The temperature dependence of hypersonic longitudinal and transverse sound waves in "strong" (B_2O_3) and "fragile" [$Ca_{0.4}K_{0.6}(NO_3)_4$] glass-forming systems have been probed using Brillouin scattering. In the latter material the transverse modes become masked by a central component in the spectrum which broadens as the temperature is raised through the liquidus temperature; in B_2O_3, on the other hand, well-defined (undamped)

transverse modes are observed above the melting temperature of crystalline B_2O_3 (~723 K) all the way to 1300 K.

34044 Study of local magnetic properties of an adsorbate by spin-polarized Auger-electron spectroscopy. Sinkovic, B. (AT&T Bell Laboratories, Murray Hill, New Jersey 07974 and Physics Department, Brookhaven National Laboratory, Upton, New York 11973(US)); Johnson, P. D.; Brookes, N. B.; Clarke, A.; Smith, N. V. *Physical Review Letters (USA),* 62(23): 2740-2743 (5 Jun 1989). DOE Contract AC02-76CH00016.

The spin-polarized sulfur $L_{2,3}VV$ Auger spectrum isrecorded for the system $c(2\times2)$S/Fe(001). Convolution of thecalculated spin-dependent projected local density of states gives goodagreement with the measured spectrum. As in previous studies a strong satelliteis observed in the Auger spectrum and this is shown to be due to the presenceof hybridized iron states at the sulfur site. The spectrum also shows anexchange splitting of 0.2 eV in reasonable agreement with the calculation. Theintegrated spin-up and spin-down Auger intensity gives an estimate of themagnetic moment of the sulfur adsorbate $\leq 0.10\mu_B$.

34045 Adsorption and interaction of Sb on Si(001) studied by scanning tunneling microscopy and core-level photoemission. Rich, D. H. (Department of Physics, University of Illinois at Urbana-Champaign, 1110 West Green Street, Urbana, Illinois 61801(US)); Leibsle, F. M.; Samsavar, A.; Hirschorn, E. S.; Miller, T.; Chiang, T. *Physical Review [Section] B: Condensed Matter (USA),* 39(17): 12758-12763 (15 Jun 1989). DOE Contract AC02-76ER01198.

Scanning tunneling microscopy (STM) and synchrotron photoemission were used to analyze the Sb/Si(001) interface formation for submonolayer and saturation coverages. The surface-shifted core-level component observed in photoemission for Si(001)-(2×1) was suppressed with the adsorption of Sb. Constant-current STM images which were taken for different sample biasconditions show changes in the spatial distribution of the occupied and unoccupied states derived from the Si-dimer dangling bonds upon Sb adsorption.These observations are interpreted in terms of the formation of Sb-Sibonds and the resulting modifications in the surface electronic properties.

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Refer also to citation(s) 33113, 33155, 33214, 33310, 33348, 33479, 33562, 33563, 33706, 33754, 33755, 33908, 33948, 34032, 34089, 34722, 34723, 34724, 34756, 34920

34046 (AECL–8951) **Analysis of hydrocarbons by dual-energy gamma-ray densitometry.** Taylor, T.; Reynolds, P.W.; Lipsett, J.J.; Liu, D.D.S. Atomic Energy of Canada Ltd., Chalk River, ON (Canada). Chalk River Nuclear Labs. Nov 1985. 14p. Order Number DE89619118/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Various hydrocarbons have been analyzed noninvasively by dual-energy gamma-ray densitometry. The hydrogen/carbon atomic ratio was deduced for pure hydrocarbons while for heavy oil process samples, the ash content was inferred.

34047 (ARC–1989, pp. 9) **Fractionation of oil sands bitumen and coal derived liquids.** Moschopedis, S.E. (Alberta Research Council, Edmonton); Hawkins, R.W. Alberta Research Council, Edmonton, AB (Canada). [1989]. (CE–02438). In *Alberta Research Council [research reports].* Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages.

This report summarizes the results of a number of chromatographic methods for the fractionation of petroleum and coal derived liquids. Methods and techniques are described for the quantitative separation of these liquids into ill-defined fractions, such as asphaltenes, resins, and oils. The prime objective of this preliminary investigation is to find the most efficient and least time-consuming fractionation procedure by comparing various methods. The data indicate that the pentane soluble fractions from bitumen, anthracene oil and coal derived liquids can be chromatographically separated into the same type of hydrocarbon groups (oil and resins) by either method, the modified SARA or the high perfomance liquid chromatography. 8 refs., 8 figs., 6 tabs.

34048 (BNL–42711) **An x-ray microprobe facility using synchrotron radiation.** Gordon, B.M.; Jones, K.W.; Hanson, A.L.; Pounds, J.G.; Rivers, M.L.; Spanne, P.; Sutton, S.R. Brookhaven National Lab., Upton, NY (USA). 1989. 13p. Sponsored by DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-890410–2: Nuclear analytical methods in the life sciences, Gaithersburg, Maryland, USA, 17-21 Apr 1989). Order Number DE89012973/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A x-ray microprobe for trace elemental analysis at micrometer spatial resolutions using synchrotron radiation (SR) is under development. The facility consists of two beamlines, one including a 1:1 focusing mirror and the other an 8:1 ellipsoidal mirror. At present "white light"' is used for excitation of the characteristic x-ray fluorescence lines. Sensitivities in thin biological samples are in the range of 2-20 fg in 100 μm^2 areas in 5 min irradiation times. Scanning techniques as well as microtomography and chemical speciation are discussed. Application to a specific biomedical study is included. 13 refs., 2 figs.

34049 (CEA-CONF–9289) **Optogalvanic spectroscopy in flames.** Berthoud, T.; Benchehida, M.; Mauchien, P. CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI). 1987. 6p. (In French). (CONF-8707107–: 1. international conference on laser M2P, Lyon-Villeurbanne, France, 7-9 Jul 1987). Order Number DE89781528/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

none

34050 (CEA-CONF–9777) **Gaseous elements in metals.** Andreani, A.M. CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Chimie Appliquee et d'Etudes Analytiques. 1988. 9p. (In French). (CONF-8806285–: 31. colloquium of metallurgy at Saclay on gas in materials, Saclay, France, 20-22 Jun 1988). Order Number DE89781585/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

A number of usual methods for the determination of gases in metals are described: chemical methods, vacuum fusion, inert gas fusion, nuclear reactions. Intercomparison results and possibilities offered by various techniques are discussed.

34051 (CNEA–486) **X-Ray fluorescence of microquantities of hafnium in zirconium by precipitation as thin film.** Informe. Vigoda de Leyt, Dora; Caridi, A.F.; Deibe, Jorge. Comision Nacional de Energia Atomica, Buenos Aires (Argentina). 1988. 11p. (In Spanish). Order Number DE89619112/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Informe.

The importance of Zr and Hf in the nuclear industry represents and increasing need for the development of reliable chemical methods to determine Hf traces in Zr matrix. A precipitation method in amoniacal medium was developed. A thin film is obtained where matrix effects are absent or minimized. Hf in the range of $5\text{-}70.10^{-9}$Kg in a 5.10^{-6}Kg Zr matrix was studied. Fluorescence Hf Lα and Hf Lβ X-rays are excited by a W-anode tube 17 kV-25mA and 50kV-25mA. Radiation scattered by the tube was used as internal standard. Bartlett criterion was used for the regression analysis. Determination limit was fixed in $5\pm4.\ 10^{-9}$Kg Hf at a 95 % probability.

34052 (CONF-8810133–6) **Fiber-optic surface-enhanced Raman system for field screening of hazardous compounds.** Ferrell, T.L.; Goudonnet, J.P.; Arakawa, E.T.; Reddick, R.C.; Gammage, R.B.; Haas, J.W.; James, D.R.; Wachter, E.A. Oak Ridge National Lab., TN (USA). 1988. 2p. Sponsored by DOE Energy Research. DOE Contract AC05-84OR21400. From 1. international symposium on field screening methods for hazardous waste site investigations; Las Vegas, Nevada, USA; 11-13 Oct 1988. Order Number DE89013013/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Surface-enhanced Raman scattering permits identification of compounds adsorbed onto a metal microbase that is microlithographically produced with submicron resolution. Less than one

percent of a monolayer of a Raman Active target compound offers a high signal-to-noise ratio. By depositing the microbase on the exterior of a fiber optic cable, convenient field screening or monitoring is permitted. By using highly effective microbases, it is possible to reduce laser power requirements sufficiently to allow an economical, but complete, system to be housed in a suitcase. We shall present details of SERS system of this type and shall show data on samples of interest in the screening of hazardous compounds.

34053 (DOE/ER/13552–T1) **Analysis and computer tools for separation processes involving nonideal mixtures: Progress report, June 1, 1986–November 30, 1989.** Lucia, A. Clarkson Univ., Potsdam, NY (USA). May 1989. 8p. Sponsored by DOE Energy Research. DOE Contract FG02-86ER13552. Order Number DE89013470/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The objectives of this research, as stated in the original proposal, were to further both the theoretical understanding of and the development of computer tools (algorithms) for separation process models involving nonideal homogeneous and heterogeneous mixtures. By a homogeneous mixture, we mean any mixture for which both the vapor and liquid phases are materially stable for all temperatures, pressures, and compositions of interest. A heterogeneous mixture, on the other hand, is any mixture that possesses the potential to split into two (usually liquid) phases for some conditions of temperature, pressure, and composition. 12 refs.

34054 (GCLL–8804) **Development and evaluation of analytical methods for the determination of trace polymers in coal and oil process waters. Final report.** Pandey, R.N. Guelph Cehmical Labs., ON (Canada). 1988. 234p. (MICROLOG–88-05988). Available from Canada Centre for Mineral and Energy Technology, Technical Information Division, 555 Booth St., Rm. 342, Ottawa, , Canada K1A 0G1; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This report presents and discusses the results of CANMET/CRL research work on the development and evaluation of analytical methods for the determination of residual polyacrylamide (PAM) polymers in coal and oil process waters. The objective of the study is related to the improvement of the quality of coal, oil, and other industrial process waters for reuse or disposal. In the study, economical, rapid, and routinely applicable spectrophotometric methods have been developed for the analysis of cationic, anionic, and nonionic PAM polymers in coal and oil process waters. The method development studies include: triiodide method, starch-triiodide method, and Leuco crystal violet method. Applications to real coal and oil process water samples have been made. PAMs were characterized by elemental analysis (C, H, N, O). As part of the method development, spiking and recovery studies were carried out at various concentrations of PAM and absorbance measurements were optimized. All three methods studied were optimized for sensitivity in terms of the following parameters: pH, effect of reagents, chlorides, iodides, metals, and organic compounds likely to be present in process waters. The results indicate that the newly developed Leuco crystal violet method is the best in terms of simplicity, as well as being economical and routinely applicable in the field or laboratory. 29 refs., 69 figs., 17 tabs.

34055 (IAEA-AL–006) **Report on the intercomparison run IAEA-083 radionuclides in simulated airfilters.** Cooper, E.L.; LaBreque, J.J.; Hanna, A.H.; Dekner, R.; Scott, T.; Strachnov, V.; Schelenz, R. International Atomic Energy Agency, Seibersdorf (Austria). Laboratories. Nov 1988. 22p. Order Number DE89619119/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The results of the intercomparison for the determination of activity concentrations of simulated air filters (IAEA-083) are reported. Data of twenty-one laboratories from fourteen different countries have been considered and include the determination of the following radionuclides: ^{133}Ba, ^{60}Co, ^{137}Cs, ^{210}Pb and ^{90}Sr. According to a statistical evaluation sufficient data for mean values and confidence intervals (significance level 0.05) are recommended for: ^{60}Co: 2160 (2093 - 2227) Bq/filter; ^{137}Cs: 1182 (1118 - 1246) Bq/filter; ^{90}Sr: 231 (222 - 241) Bq/filter; Reference date: 1 January 1986. Figs and tabs.

34056 (IAEA-AL–012) **Report on the intercomparison run SD-A-1 radionuclides in marine sediment.** International Atomic Energy Agency, Monaco-Ville (Monaco). Lab. of Marine Radioactivity. Dec 1988. 30p. Order Number DE89617880/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The International Laboratory of Marine Radioactivity (ILMR) at Monaco, following a request given to it by CRESP (Coordinated Research and Environmental Surveillance Programme for Sea Disposal, OECD/NEA) organized during 1986-1987 an intercomparison exercise for determining the concentrations of natural and artificial radionuclides in a sample of deep sea sediment. Including the nine CRESP participants, samples were sent to fifty-one laboratories in twenty-eight countries. It was anticipated that the concentrations of the artificial radionuclides in this sediment would be at or below analytical detection limits. Participating laboratories were requested to determine as many radionuclides as possible from the following list: ^{60}Co, ^{90}Sr, ^{137}Cs, transuranium elements, natural radionuclides such as ^{40}K, uranium isotopes, thorium isotopes, ^{226}Ra, ^{210}Pb and ^{210}Po. In the information sheet provided it was stated that the concentrations of artificial radionuclides were very low and could be close to detection limits. The analysts were requested to make, whenever possible, at least three determinations for each radionuclide reported. They were also asked to report net rate activity in the sample, as either a negative or a positive value. An Atlantic marine sediment was collected in Autumn 1985, by box-corer from the area 46 deg. to 48 deg.30' North and 18 deg. to 22 deg. East. The water depth in that area is more than 4000m. Activities of the natural radionuclides in the selected samples did not deviate by more than 8%. Thirty-four laboratories from twenty countries have reported data on the following radionuclides ^{40}K, ^{60}Co, ^{90}Sr, ^{210}Pb, ^{210}Po, ^{137}Cs, ^{226}Ra, ^{228}Ra, ^{228}Th, ^{230}Th, ^{232}Th, ^{234}U, ^{235}U, ^{238}U, ^{238}Pu, $^{239+240}$Pu and ^{241}Am. 6 refs, 12 tabs.

34057 (IPEN-PUB–214) **Thermoionic emission characteristics of uranium with application to its determination by MSID technique using ^{233}U tracer.** Shihomatsu, H.M.; Iyer, S.S. Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil). 1988. 63p. (In Portuguese). Order Number DE89617882/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

Experimental details of the uranium determination in geological samples (50-1500 ppm range) by mass spectrometric isotope dilution technique (MSID) employing ^{233}U tracer are presented. For this purpose the thermoionic emission characteristics of uranium in various filament arrangements like simple plane, filament boat, double, are studied and the most efficient one selected for the isotope dilution analysis. The various experimental procedures involved in the MSID like sample dissolution, chemical separation and mass spectrometric analysis are developed and optimised. The experimental results on the uranium determination by MSID with ^{233}U tracer yielded precision and accuracy of 0,5% and 1% respectively. The importance of the sampling in the precise and accuracy determination of uranium in geological samples, where it is heterogeneously distributed, is discussed.

34058 (IPNO-DRE–87-43) **Gamma and e^- spectroscopic study of high spin short period isomers, using the recoil method.** Lagrange, J.M.; Pautrat, M.; Dionisio, J.S.; Vieu, C.; Vanhorenbeeck, J. Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire. 1987. 55p. (In French). Order Number DE89781509/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

The γ and conversion electron de-excitation spectra of nuclei, produced through (H.I., xn) reactions, are spoiled by various phenomena, most of them related to the reaction itself. When, in the isotopes studied one or several isomers are present, the half-life of the higher energy one being about 15 ns or more, then the compound nucleus recoil method can provide much cleaner spectra. This method is extensively described and discussed here, together with others, more briefly treated, also meant to reduce the unwanted effects; these techniques may be used either separately or combined, depending on the experiments performed. Examples of the results obtained are shown to illustrate the substantial improvements reached.

34059 (LBL–26712) **A semi-micro Soxhlet extraction method for the determination of extractable particulate organic**

matter and selected polycyclic aromatic hydrocarbons. Daisey, J.M.; Gundel, L.A.; Wang, L. Lawrence Berkeley Lab., CA (USA). Feb 1989. 17p. Sponsored by DOE/CE;DOE/EH. DOE Contract AC03-76SF00098. Order Number DE89012832/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A semi-micro-Soxhlet extraction method has been developed for the determination of extractable particulate organic matter and selected polycyclic aromatic hydrocarbons in samples of particulate matter collected in homes in which concentrations are about 10 $\mu g\text{-}m^{-3}$ or more. The method involves a sequential extraction in a micro-Soxhlet apparatus with dichloromethane (DCM) followed by an optimal extraction with acetone (ACE). The extracts are then filtered in a specially developed semi-micro filtration/evaporation apparatus and brought to a final volume of 1.0 ml for extract weight determination. An aliquot of the DCM fraction is then analyzed for selected polycyclic aromatic hydrocarbons (PAH) by high pressure liquid chromatography (HPLC) using fluorescence detection for high sensitivity. 7 refs.

34060 (MLM–3594) **Mound activities in chemical and physical research, July–December 1988.** EG and G Mound Applied Technologies, Miamisburg, OH (USA). 15 Jun 1989. 25p. Sponsored by DOE Defense Programs. DOE Contract AC04-88DP43495. Order Number DE89012825/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

In July–December 1988 progress report, three research program summaries conducted at Mound Laboratory are presented. Separation Research: Liquid Phase Thermal Diffusion — to separate Si-28 by liquid phase thermal diffusion of tetramethylsilane was completed. Calcium Chemical Exchange — investigations of cryptand and chelex calcium chemical exchange systems were concluded with an evaluation of their potential for use in an enrichment process. Transport Property Research: Thermal Diffusion of Polyatomic Gases — Thermal diffusion factors in three noble gas/SF_6 and Kr-SF_6 behaved normally; the thermal diffusion factors the increased as the temperature increased.

34061 (ORNL–6547) **Analytical Chemistry Division annual progress report for period ending December 31, 1988.** Oak Ridge National Lab., TN (USA). May 1988. 130p. Sponsored by DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89013736/JAW. Available from NTIS, PC A07/MF A01 - OSTI; GPO Dep.

The Analytical Chemistry Division of Oak Ridge National Laboratory (ORNL) is a large and diversified organization. As such, it serves a multitude of functions for a clientele that exists both in and outside of ORNL. These functions fall into the following general categories: (1) Analytical Research, Development, and Implementation. The division maintains a program to conceptualize, investigate, develop, assess, improve, and implement advanced technology for chemical and physicochemical measurements. Emphasis is on problems and needs identified with ORNL and Department of Energy (DOE) programs; however, attention is also given to advancing the analytical sciences themselves. (2) Programmatic Research, Development, and Utilization. The division carries out a wide variety of chemical work that typically involves analytical research and/or development plus the utilization of analytical capabilities to expedite programmatic interests. (3) Technical Support. The division performs chemical and physicochemical analyses of virtually all types. The Analytical Chemistry Division is organized into four major sections, each of which may carry out any of the three types of work mentioned above. Chapters 1 through 4 of this report highlight progress within the four sections during the period January 1 to December 31, 1988. A brief discussion of the division's role in an especially important environmental program is given in Chapter 5. Information about quality assurance, safety, and training programs is presented in Chapter 6, along with a tabulation of analyses rendered. Publications, oral presentations, professional activities, educational programs, and seminars are cited in Chapters 7 and 8.

34062 (ORNL/FTR–3268) **[Third international conference on separations technology, Davos, Switzerland, and visit to Zurich, May 12–19, 1989]: Foreign trip report.** Basaran, O.A. Oak Ridge National Lab., TN (USA). 6 Jun 1989. 7p. Sponsored by DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89014749/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The traveler visited the Swiss Federal Institute of Technology to discuss research of mutual interest in the areas of drop dynamics and separations with members of Professor S. Hartland's research group. The traveler also attended the Third International Conference on Separations Technology and presented a paper on drop coalescence. Papers of particular interest to ORNL involved the use of membranes and bioreactors for separations and processing and advances in design and scaleup of extraction equipment. Some of these papers may be relevant to fuel recycle and waste cleanup applications.

34063 (RFP–4317) **Pilot-scale production of dicesium hexachloroplutonate (Cs_2PuCl_6) and filtrate recovery.** Muscatello, A.C.; Stevens, J.R.; Killion, M.E.; Valdez, J.D.; Ames, R.L. Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant. 15 Mar 1989. 27p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP03533. (CONF-8905122–4: 13. actinide separations conference, Idaho Falls, Idaho, USA, May 1989). Order Number DE89013523/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The Rocky Flats Plant is introducing the use of dicesium hexachloroplutonate (DCHP) into the Molten Salt Extraction Process (MSE). DCHP (Cs_2PuCl_6) extracts americium from molten plutonium metal into a molten calcium chloride matrix. The DCHP is produced by precipitating plutonium (IV) from hydrochloric acid with cesium chloride. Before production of the DCHP began, we performed a pilot-scale test to determine yields, track impurities, and test filtrate recovery for the proposed process. In the course of this study, we determined that impure plutonium oxide (0.80 g/g) dissolved in concentrated HCl is an acceptable source of plutonium for the DCHP. We also determined that dissolved oxide and chloride anion exchange eluate can be mixed for DCHP preparation. We found that DCHP yields average 92-95% at 8M total chloride and are independent of sparging rate and time. Furthermore, we found that drying at 150°C for 5 hr gives <0.1% water in the DCHP only if it is preceeded by extensive air drying. Finally, we proved the efficiency of chloride anion exchange for the recovery of above-discard plutonium from the filtrate. 11 refs., 1 fig., 11 tabs.

34064 (RISO-M–2739) **Determination of ^{99}Tc in environmental samples by anion exchange.** Qing Jiang Chen; Aarkrog, A.; Dahlgaard, H.; Nielsen, S.P.; Jensen, H.L.; Bruun, J.; Holm Pedersen, A.; Mandrup, K. Risoe National Lab., Roskilde (Denmark). Jul 1988. 20p. Order Number DE89617894/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The chemical yield of technetium by an anion exchange (AG 1-X_4) procedure is determined under different conditions from 200 liters sea water. A new method for collection ^{99}Tc from 200-400 liters sea water has been developed by anion exchange. The evaporation rates of RuO_4 and TcO_4^- are determined at 100 deg. C in 0.1 N H_2SO_4. A higher decontamination factor 2.5 x 10^5 - 2.4 x 10^7 for ruthenium is obtained by evaporating the RuO_4 at 100 deg. C in 0.1 N H_2SO_4. The ruthenium is oxidized to RuO_4^- with NaC1O at pH = 9. $Fe(OH)_3$ scavenging, AgCl precipitation and 5% TIOA/xylene extraction at controlled valence are used for decontamination of ruthenium, ^{110m}Ag and other nuclides. The chemical yield of technetium-99 in the procedure is about 70%.

34065 (SAND–88-3367C) **Partial least-squares calibration diagnostics applied to the FT-IR analysis of borophosphosilicate glass (BPSG) thin films.** Haaland, D.M. Sandia National Labs., Albuquerque, NM (USA). 1989. 14p. Sponsored by DOE/DP;OUS. DOE Contract AC04-76DP00789. (CONF-890674–2: 7. international conference on Fourier transform spectroscopy, Fairfax, Virginia, USA, 19-23 Jun 1989). Order Number DE89014739/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Full-spectrum multivariate calibration methods are capable of providing a multitude of diagnostic capabilities for evaluating the quality of the calibration, identifying problem calibration samples, and flagging unknown samples whose analysis by these methods might be unreliable. These diagnostics are demonstrated for the analysis of BPSG thin films on silicon using infrared spectroscopy and partial least-squares methods. 3 refs., 1 fig.

34066 (STEV-FBT–89-21) **Quantitative analysis or samples from fluidized bed coal combustors by X-ray diffraction.** Langer, V. Statens Energiverk, Stockholm (Sweden). Nov 1988. 27p. (CTH-OOK–88-13). Order Number DE89776263/JAW. Available from NTIS (US Sales Only), PC A03/MF A01;1.

The results of X-ray powder diffraction quantitative analysis (X) for six samples are presented together with results obtained by classical wet-chemical (atom absorption spectroscopy, CO_2-gas analysis, S-analysis) analysis (WCA). The WCA-method cannot distinguish between CaO and $Ca(OH)_2$ and therefore only the content of CaO is presented. Values obtained by these two methods are mostly in agreement, taking into account their statistical errors. Some values disagree, especially those for SiO_2, where the WCA value is systematically much higher that obtained by X-ray powder diffraction. This might be explained by presence of different silicates in the sample (as Al_2SiO_5), which are all counted as SiO_2 by the WCA-method. X-ray powder diffraction can be used for relatively quick and reliable quantitative analysis of quite minute amount of samples in FBC ashes with added limestone as SO_2 sorbent.

34067 Experimental measures of the electron distribution and bonding in bis(η^5-cyclopentadienyl) osmium from He(I) and He(II) valence photoelectron spectroscopy. Lichtenberger, D. L. (Laboratory for Electron Spectroscopy and Surface Analysis, Department of Chemistry, University of Arizona, Tucson, Arizona 85721(US)); Copenhaver, A. S. *Journal of Chemical Physics (USA)*, 91(2): 663-673 (15 Jul 1989).

The He(I) and He(II) high resolution photoelectron spectra of osmocene are reported. Vibrational fine structure is observed in all the valence metal-based ionizations and in the cyclopentadienyl π ionizations which derive from the e_{1g} and e_{1u} symmetry combinations. Analysis of the vibrational progressions found in the metal-based ionizations provides a measure of the force constants and vibrational frequencies for the metal–ring stretch in the positive ions. The vibrational analysis for the $^2E_{2(5/2)}$ and $^2E_{2(3/2)}$ states of the osmocene cation [derived from the spin–orbit split ionization of the metal $e_{2g}(d_{x^2-y^2}, d_{xy})$ set] indicates an 0.12 A greater metal–ring bond length in the cation compared to the neutral molecule. The sharp $^2A_{1(1/2)}$ ionization [correlating with removal of an electron from the metal $a_{1g}(d_{z^2})$ orbital] is observed to have a much shorter vibrational progression. The adiabatic ionization is the most intense (vertical) band of the series, indicating that there is no appreciable change in metal–ring bond distance upon ionization from the nonbonding $a_{1g}(d_{z^2})$ orbital to produce the $^2A_{1(1/2)}$ cationic state. A large spin–orbit coupling is observed in the metal ionization region and a moderate amount in the cyclopentadienyl ring π ionization region. From evaluation of the spin–orbit coupling, the ionization band which correlates primarily with the e_{1g} combination of the cyclopentadienyl π orbitals is shown to contain about 27% metal character.

34068 Gas-solid chromatography: longitudinal and intraparticle diffusion of acetylene in activated carbon. Forsythe, R. (Kent State Univ., OH (USA)); Madey, R.; Photinos, P.J.; Rothstein, D.; Huang, J.C. *Separation Science and Technology (USA)*, 23(14-15): 2319-2328 (Nov-Dec 1988).

The time-dependent transmission of 100 ppm acetylene in helium at 1 atm through columns of Columbia 4LXC 12/28 activated carbon at 25°C was measured at several flow rates in the range from about 1 to 7 cm^3/s. Transmission is the gas-phase concentration at the column outlet divided by the input concentration. The gas- and adsorbed-phase diffusion coefficients were calculated from a homogeneous-solid diffusion model by means of the method of moments. The gas-phase diffusion coefficient was constant in this range of flow rates. Fitting the experimental transmission curves to a theoretical transmission expression for a model with only gas-phase diffusion indicated that solid-phase diffusion in this carbon cannot be neglected at high flow rates.

4002 Inorganic, Organic and Physical Chemistry

Refer also to citation(s) 33098, 33100, 33180, 33217, 33310, 33341, 33345, 33346, 33347, 33353, 33358, 33410, 33631, 33632, 33970, 34060, 34061, 34093, 34470, 34727, 35221, 35222

34069 (ARC–1989, pp. 11) **Sorptive and activity behaviour of iron minerals for hydrocarbon synthesis.** Parkash, S. (Alberta Research Council, Edmonton); Kretschmer, H.O.; Chakrabartty,k. Alberta Research Council, Edmonton, AB (Canada). [1989]. (CE–02438). In *Alberta Research Council [research reports]*. Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages.

The sorptive behavior of hydrogen and of carbon monoxide and of their mixtures on a low grade iron ore, magnetite, hematite and a commercial synthetic NH_3-iron catalyst was studied in an attempt to describe their catalytic properties for Fischer-Tropsch hydrocarbon synthesis. In comparison to hydrogen and carbon monoxide adsorbded individually, the adsorption of both gases is enhanced invariably when adsorbed simultaneously from the mixture. Sorption of hydrogen is enhanced by the presorption of carbon monoxide on the catalyst surface while a small amount of presorbed hydrogen hardly enhances the carbon monoxide adsorption. Initial rates of carbon monoxide hydrogenation, which are most representative of clean surfaces, measured over the temperature range 250-360°C, are in the order hematite>magnetite>synthetic-NH_3-iron>iron ore. From the initial rates, the selectivity for methane formation at 250°C for all the four catalysts is about 20 per cent. 28 refs., 2 figs., 6 tabs.

34070 (DOE/ER/13774–T1) **[Studies of the fundamental nature of catalytic acidity, sites, and intermediates]: Progress report.** Pittsburgh Univ., PA (USA). Dept. of Chemistry. [1989]. 5p. Sponsored by DOE Energy Research. DOE Contract FG02-87ER13774. Order Number DE89012946/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Advances in the understanding of the acidic and catalytic properties of H-zeolites have been achieved from several kinds of experiments. These included: (1) MASNMR studies of adsorbed alcohols, (2) optical spectroscopy of Hammett indicators, (3) studies of the kinetics and mechanisms of the catalytic decomposition of isobutane and neopentane, (4) site poisoning experiments using NH_3, and (5) preparation and characterization of dealuminated zeolites by ^{29}Si and ^{27}Al MASNMR, ^1H-NMR, x-ray diffraction and physical adsorption.

34071 (DOE/ER/13880–1) **Late transition metal μ-oxo and μ-imido complexes: Progress report, May 15, 1988–May 14, 1989.** Sharp, P.R. Missouri Univ., Columbia, MO (USA). 1989. 5p. Sponsored by DOE Energy Research. DOE Contract FG02-88ER13880. Order Number DE89012945/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This project is a study of the synthesis and reactivity of μ-oxo and μ-imido complexes of the second and third series metals of groups 9–11. Our interest in these complexes arises from (1) our desire to model surface species present in catalytic reactions (ethylene epoxidation on Ag, NH_3 oxidation on Pt, NO reduction by CO on Rh, O_2 electroreduction on Pt) and (2) the unique reactivity associated with complexes of "hard" ligands with "soft" metals. Preparation and reactions of Rh complexes and Au complexes are discussed. 9 refs.

34072 (EMR/CRL–88-33) **Interfacial thermodynamics and adsorption. 1. An introduction to surface energetics and a survey of temperature dependence studies.** Angle, C.W. Department of Energy, Mines and Resources, Ottawa, ON (Canada). Coal Research Labs. Div. 1988. 67p. (MICROLOG–89-00470). Available from Canada Centre for Mineral and Energy Technology, Technical Information Division, 555 Booth St., Rm. 342, Ottawa, ON, Canada K1A 0G1; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Colloids are part of many disciplines of applied science and everyday technology products. Interfacial properties dominate the behaviour of colloidal systems. To understand these systems, a thorough appreciation of interfacial thermodynamics is useful, especially when adsorption occurs. The principles that govern interfaces of liquid/liquid, liquid/solid and liquid/vapour systems are discussed in relation to adsorption and the Gibbs Surface Excess. The Guggenheim-Adams model is compared with the Gibbs model. The former becomes more complex in mathematical treatment for liquid/liquid systems, especially if polymers are considered as the adsorbate. When the interphase volume is significant, the former is useful. Where simplicity and generality are required, the latter

model is suitable. Special features of adsorption relative to thermodynamic properties, problems and assumptions for complex heterogeneous systems are discussed. Heats of immersion and heat capacities are shown to be useful in determining surface tension of solids of the same material. The influence of temperature increase on surface entropy of liquid/vapour and liquid/liquid interfaces is surveyed with examples taken from many disciplines. Classical empirical relations developed in the past are illustrated in examples taken from metallurgy and heat transfer studies. Surface entropy as influenced by changes in adsorption with increased temperature is discussed in relation to polarography, polymers, proteins, surfactants and emulsions. Special emphasis is given to enhanced oil recovery. 33 refs., 10 figs., 4 tabs.

34073 (IBK–1603) **Determination of thermodynamic equilibrium constants of ion exchange and solvent extraction processes.** Petrovicj, Dj. Institut za Nuklearne Nauke Boris Kidric, Belgrade (Yugoslavia). 1985. 19p. Order Number DE89617898/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Determination of the thermodynamic equilibrium constants of ion exchange and solvent extraction processes has been considered on the base of the calculation of the chemical activity coefficients from distribution concentration data or by means of a direct method. (author). 9 refs.; 1 tab.

34074 (INIS-mf–11456, pp. 287-290) **Electronic structure and magnetism of 5f systems.** Havela, L. (Karlova Univ., Prague (Czechoslovakia). Fakulta Matematicko-Fyzikalni); Sechovsky, V. Jednota Ceskoslovenskych Matematiku a Fyziku, Prague (Czechoslovakia). 1987. (In Czech). (CONF-8707217–: 9. conference of Czechoslovak physicists, Pardubice, Czechoslovakia, 6-10 Jul 1987). In *Ninth conference of Czechoslovak physicists. Part 1, 2.* Order Number DE89617602/JAW. Available from NTIS (US Sales Only), PC A22/MF A01 - OSTI; INIS.

Actinides - elements Th through Lr are characterized by the gradual filling of 5f electronic states. The magnetic properties of atoms are primarily determined by the ratio of the magnitude of intra-atom Coulomb repulsion and the width of the 5f band. The development of the localization of 5f states and the related changes in the magnetic behavior are demonstrated on compounds of the type UTX (U - uranium, T - transition metal, X - Al, Ga or Sn). A diagram is presented of the development of the following magnetic parameters - Currie temperature, Neel temperature, spontaneous magnetic moment, magnetic susceptibility, linear coefficient of specific thermal capacity. The reasoning is found to be justified about the impact of delocalization mechanisms on the development of the electronic structure of light actinide compounds. (M.D.). 3 figs., 1 tab., 6 refs.

34075 (LBL–25560) **The old and the new: Studies of metal-catalysed exchange by sup 3H NMR spectroscopy.** Williams, P.G.; Morimoto, Hiromi; Salijoughian, M. Lawrence Berkeley Lab., CA (USA). Jun 1988. 6p. Sponsored by DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-880787–4: 3. international symposium on the synthesis and applications of isotopically labeled compounds, Innsbruck, Austria, 17-21 Jul 1988). Order Number DE89013691/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Studies of the use of platinum, palladium and Raney nickel catalysts for exchange into organic substrates under mild conditions have been undertaken. Encouraging results were obtained with Raney nickel as catalyst, with high activity and specificity of label, with a number of pilot experiments yielding tritiated hydrocarbons with specific activities in the region of 30-400 GBq/mmole. NMR analyses of products and have shown that the mechanism of the exchange process is accessible, that aromatic vs aliphatic effects may be quantified, and that the resolution of modern day NMR instruments allows simple resolution of multiply labeled species. With extension of these experiments to more diverse substrates, and with careful radio-GLC and ^{3}H NMR analyses, we have gained insight into the range of application and the exchange mechanisms of these procedures. 13 refs., 2 figs., 1 tab.

34076 (LBL–25587) **A new route towards the synthesis of multi-tritiomethyl iodide.** Saljoughian, M.; Morimoto, H.; Rapoport, H. Lawrence Berkeley Lab., CA (USA). Jun 1988. 5p. Sponsored by DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-880787–5: 3. international symposium on the synthesis and applications of isotopically labeled compounds, Innsbruck, Austria, 17-21 Jul 1988). Order Number DE89013690/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A new procedure for the synthesis of multi-tritiated methyl iodide is reported. In this procedure trichloromethylphenyl sulfide was prepared and the trichloromethyl group was hydrogenolysed in the presence of 10% Pd/C and an organic base with deuterium gas to give the corresponding deuterated sulfide as the precursor. Upon heating a mixture of the latter with excess of benzyl iodide in a special apparatus benzylphenyl sulfide remained as a solid by-product and liberated deuteriated methyl iodide was directly reacted with several simple amines to be N-deuteriomethylated. This new synthetic method can be extended to the tritiomethyl labeling of a variety of organic compounds having a methyl group attached to a heteroatom such as N, O and S. 12 refs.

34077 (NEI-FI–75) **Chemical pulping spent liquor rheological properties and viscosity.** Salin, J.G. Kauppa-ja Teollisuusministerio, Helsinki (Finland). Energiaosasto. 1988. 28p. (In Finnish). Order Number DE89776167/JAW. Available from NTIS (US Sales Only), PC A03/MF A01;1.

The objective of this investigation was to study how fluid flow properties of spent liquors from chemical pulping processes deviate from normal Newtonian fluids. The non-Newtonian properties of spent liquors were studied and concretized and the practical importance of these properties was analyzed. The results show clearly that black liquor behaves as a non-Newtonian fluid under certain circumstances. Below a certain flow shear rate limit the flow is Newtonian but above that limit black liquor is a pseudoplastic fluid, that is, the apparent viscosity decreases as the flow gets more violent. Based on data available, formulas giving the pressure drop and heat transfer for black liquor laminar and turbulent pipe flow have been derived. Example calculations show that black liquor rather seldom behaves as a non-Newtonian fluid under practical mill conditions. These non-Newtonian phenomena are, however, not without practical importance. The most important influence is on laboratory viscosity measurement procedures and the results show that the measurement methods for black liquor viscotiy require more consideration. In addition to the phenomena mentioned above, it was observed that black liquor properties may change as a function of time. Thixotropic behaviour was observed in a few cases but a more important phenomen is permanent changes, for instance in viscosity, due to chemical decay reactions. This gives an opportunity for the mills to affect black liquor viscosity, for instance, by a heat treatment. There are very little experimental data on rheological properties for other spent liquors than black liquor.

34078 (SVF–316) **Humus, decomposition products. Analysis methods for identification and quantitative analysis of hydrocarbons.** Warman K.; Falk, I. Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden). Oct 1988. 54p. (In Swedish). Order Number DE89776244/JAW. Available from NTIS (US Sales Only), PC A04/MF A01;1.

Laboratory studies aimed at testing the application of various analysis techniques for the quantitative analysis of hydrocarbons in water in the concentration range of micrograms and lower per liter of water have been performed. Driving off the organic hydrocarbons from water, adsorption on a hydrophobic adsorber followed by gas chromatographic analysis enables hydrocarbons with more than seven and less than eighteen carbon atoms per molecule to be analyzed quantitatively. The sensitivity of the method lies at about 1 nanogram of a given compound per liter of water. Quantitative analysis of acetic acid and propionic acid by gas chromatography preceded by an enrichment step using an anion exchange resin gave good results in the concentration range of a few micrograms per liter of water. Direct gas chromatographic analysis of acetone, methanol, acetic acid, etc., is possible in the concentration range of a few micrograms per liter of water. The method is however difficult and requires advanced gas chromatographic equipment. Direct application of gas chromatography is the most attractive solution with regard to the cost and it also has the greatest potential for further development. Ion chromatography is the best technique for the

quantitative analysis of formic acid and acetic acid in super pure process water. (authors).

34079 Vector and parallel computers for quantum Monte Carlo computations. Reynolds, P.J. (Materials and Molecular Research Div., Lawrence Berkeley Lab., Univ. of California, Berkeley, CA (US)); Alexander, S.; Logan, D.; Lester, W.A. Jr. v.v of Supercomputer simulations in chemistry. Dupuis, M. Springer-Verlag New York Inc., New York, NY (1986). (CONF-8508156–: Conference on supercomputer simulations in chemistry, Montreal, Canada, 25-27 Aug 1985).

Monte Carlo simulations are inherently compute-bound. Although short computations may provide order-of-magnitude estimates, long CPU times are generally required to achieve the accuracy needed for reliable comparison of Monte Carlo results with experiment or theory. The advent of supercomputers, which have made possible significantly increased computer speeds for those applications which are amenable to vector or parallel processing, thus offers promise for Monte Carlo applications. In fact, Monte Carlo codes are often highly parallel, and offer multiple avenues for both parallelization and vectorization. The authors explore the gains to be obtained with supercomputers for the quantum Monte Carlo (QMC) method. The QMC algorithm treated here is used in quantum mechanical molecular calculations, to obtain solutions to the Schroedinger equation. This approach has recently been shown to achieve high accuracy in electronic structure computations. QMC is here demonstrated to fully take advantage of parallel and vector processor systems. Levels of parallelism are discussed, and an overview of parallel computer architectures, as well as present vector supercomputers is given. The authors also discuss how one adapts QMC to these machines. Performance ratios (versus scalar operation) for a number of supercomputer systems are given.

34080 Reaction of chemisorbed CH and H on nickel. Yang, H. (Department of Chemistry, State University of New York at Stony Brook, Stony Brook, New York 11794-3400(US)); Whitten, J. L. *Journal of Chemical Physics (USA),* 91(1): 126-136 (1 Jul 1989).

The reaction of chemisorbed CH and H on the [111] surface of Ni is treated using a many-electron embedding theory to describe the electronic bonding, modelling the lattice as a 28-atom, three layer cluster. *Ab nitio* valence orbital CI calculations carried out on a local surface region permit an accurate description of bonding at the surface. Both CH and CH_2 species are found to bind strongly to the Ni(111) surface at threefold and bridge sites. Adsorption energies are between 2.9 and 3.1 eV for CH adsorption, and 2.5 and 2.9 eV for CH_2 adsorption. Atop Ni adsorption sites are more than 1 eV higher in energy. The Ni–C bond lengths range from 2.00 to 2.04 A for CH and CH_2 on the surface. Vibrational frequencies for HC-surface and H_2C-surface vibrations are between 400 and 600 cm^{-1}; CH stretching frequencies are around 3050 cm^{-1} in both CH and CH_2. There action of $CH+H \rightarrow CH_2$ on the nickel surface is 1.45 eV exothermic, however, a barrier exists to moving H to a threefold site adjacent to one occupied by CH. The geometries of CH and CH_2 and the nature of the bonding to the surface are discussed.

34081 Extraction of lanthanides with 2-(dihexylphosphino)-pyridine N,P-dioxide. Blaha, S.L. (New Mexico Univ., Albuquerque (USA). Dept. of Chemistry); McCabe, D.J.; Paine, R.T.; Thomas, K.W. *Radiochimica Acta (F.R. Germany),* 46(3): 123-125 (1989).

The liquid-liquid extraction properties of the bifunctional extractant 2-(dihexylphosphino)-pyridine, N,P-dioxide (NOPO) with Ce(III), Yb(III) and Eu(III) were examined in nictric acid (0.01 M -0.5 M) solutions, and the extraction mechanism was partially elucidated on the basis of distribution data.

34082 A test particle approach to the zero separation theorems of molecular distribution functions. Lee, L. L. (School of Chemical Engineering and Materials Science, The University of Oklahoma Norman, Oklahoma 73019(US)); Shing, K. S. *Journal of Chemical Physics (USA),* 91(1): 477-488 (1 Jul 1989).

It is shown that the potential distribution of *a strong testarticle* leads to the zero separation values ofthe cavity distribution functions $y_{ab}(0)$ in a mixture. This relation furnishes a direct means of computing by Monte Carlo simulations the coincidence values of the cavity function ln $y_{ab}(0)$ and the potential distribution $\langle \exp[-\beta\Psi_a - \beta\Psi_b] \rangle$. Testparticle simulations have been carried out for mixtures of Lennard-Jones molecules differing considerably in size $[(\sigma_{ab}/\sigma_{bb})^3 = 0.25, 0.5, 0.75, 1.00, 1.25, 1.50, 1.75,$ and 2.00] and in strength of interaction ($\epsilon_{ab}/\epsilon_{bb} = 0.5, 1.0, 1.5,$ and 2.0). Alternative Monte Carlo methods are employed to check the statistics. In order to predict the behavior of the potential distribution, a distribution function theory, the reference hypernetted chain (RHNC) equation, is solved based on the universality of the bridge functions. Hard sphere mixtures are taken as reference fluids. The criteria recently proposed by Rosenfeld and Blum are used to select the equivalent hard sphere diameters. Close agreement with MC results is attained for most of the states considered. This provides further evidence that the RHNC equation is a reliable theory for mixtures of simple fluids.

34083 A photoion–photoelectron coincidence study of $(N_2)_2$ and $(N_2)_3$. Norwood, K. (Ames Laboratory, U. S. Department of Energy and Department of Chemistry, Iowa State University, Ames, Iowa 50011(US)); Luo, G.; Ng, C. Y. *Journal of Chemical Physics (USA),* 91(2): 849-856 (15 Jul 1989). DOE Contract W-7405-ENG-82.

The photoion–photoelectron coincidence (PIPECO) spectra for $(N_2)^+_2$ in the wavelength range 650–866 A have been measured at different nozzle stagnation pressures. The formation of stable $(N_2)^+_2$ from fragmentation of excited $(N_2)^+_n$ cluster ions initially produced by photoionization of $(N_2)_n$, $n \geq 3$, is efficient. For nozzle expansion conditions which minimize the production of $(N_2)_n$, $n \geq 3$, the intensities for the $N^+_2(A^2,B^2)\cdot N_2$ PIPECO bands are found to be negligibly small compared to that of the $N^+_2(X^2)\cdot N_2$ PIPECO band, indicating that the electronically excited $N^+_2(A^2,B^2)\cdot N_2$ dimer ions are dissociative in temporal ranges <42 μs. Assuming that the radiative lifetimes for $N^+_2(A^2,B^2)$ and $N^+_2(A^2,B^2)\cdot N_2$ are identical, we estimate that the dissociative lifetimes for $N^+_2(A^2)\cdot N_2$ and $N^+_2(B^2)\cdot N_2$ are $\lesssim$10 μs and $\lesssim$60 ns, respectively. The ionization energy for $(N_2)_2$ is determined to be 14.50±0.08 eV (855±5 A), suggesting that $N^+_2(X^2)\cdot N_2$ is bound by 1.09±0.08 eV. The PIPECO data for $(N_2)^+_2$ presented here and those for $(CO)^+_2$ reported previously support the perturbed monomer ion model for the photoionization of a van der Waals cluster.

34084 Accurate quantum thermal rate constants for the three-dimensional $H+H_2$ reaction. Park, T. J. (The Department of Chemistry and the James Franck Institute, The University of Chicago, Chicago, Illinois 60637(US)); Light, J. C. *Journal of Chemical Physics (USA),* 91(2): 974-988 (15 Jul 1989).

The rate constants for the three-dimensional $H+H_2$ reaction on the Liu–Siegbahn–Truhlar–Horowitz (LSTH) surface are calculated using Pack–Parker hyperspherical (APH) coordinates and a C_{2v} symmetry adapted direct product discrete variable representation (DVR). The C_{2v} symmetry decomposition and the parity decoupling on the basis are performed for the internal coordinate χ. The symmetry decomposition results in a block diagonal representation of the flux and Hamiltonian operators. The multisurface flux is introduced to represent the multichannel reactive flux. The eigenvalues and eigenvectors of the J=0 internal Hamiltonian are obtained by sequential diagonalization and truncation. The individual symmetry blocks of the flux operator are propagated by the corresponding blocks of the Hamiltonian, and the J=0 rate constant $k^0(T)$ is obtained as a sum of the rate constants calculated for each block. $k^0(T)$ is compared with the exact $k^0(T)$ obtained from thermal averaging of the J=0 reaction probabilities; the errors are within 5%–20% up to T=1500 K. The sequential diagonalization–truncation method reduces the size of the Hamiltonian greatly, but the resulting Hamiltonian matrix still describes the time evolution very accurately. For the $J \neq 0$ rate constant calculations, the truncated internal Hamiltonian eigenvector basis is used to construct reduced (JK_J) blocks of the Hamiltonian. The individual (JK_J) blocks are diagonalized neglecting Coriolis coupling and treating the off-diagonal $K_J \pm 2$ couplings by second order perturbation theory. The full wave function is parity decoupled. The rate constant is obtained as a sum over J of $(2J+1)k^J(T)$.

34085 Comparison of quasiclassical trajectory calculations to accurate quantum mechanics for state-to-state partial cross sections at low total angular momentum for the reaction $D+H_2 \rightarrow HD+H$. Blais, N. C. (Chemistry Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545(US)); Zhao, M.; Mladenovic, M.; Truhlar, D. G.; Schwenke, D. W.; Sun, Y.; Kouri, D.

J. *Journal of Chemical Physics (USA)*, 91(2): 1038-1042 (15 Jul 1989).

We compare the results of classical simulations to accurate quantum studies for the reaction $D+H_2(v=0, j=1)\rightarrow HD(v\prime, j\prime)+H$ (where v and $v\prime$ are vibrational quantum numbers and j and $j\prime$ are rotational quantum numbers) on a double many-body expansion (DMBE) potential energy surface. The quantal results presented here are converged to three significant figures. We consider orbital angular momenta 0 and 1 and total angular momenta 0–2. The total energies considered, E_{tot}=0.983–1.333 eV, correspond to relative translational energy E_{rel}=0.70–1.05 eV for the v=0, j=1 vibrational–rotational state. For J=1 and odd parity, the number of channels included is up to 453 and the number of open channels is up to 177. For J=2 and even parity, the number of channels is 630 and of open channels is 147.

34086 Probing the He–H_2 potential surface with dynamical and kinetic observables. Smith, M. J. (Department of Chemistry, Princeton University, Princeton, New Jersey 08544(US)); Shi, S.; Rabitz, H. *Journal of Chemical Physics (USA)*, 91(2): 1051-1061 (15 Jul 1989).

This paper examines the effect of infinitesimal functional variations in a rigid rotor He–H_2 potential surface on several different levels of observables: inelastic cross sections, rate constants, and energy level populations. Equations are derived for the functional derivatives of these observables with respect to a variation in the potential surface. Sensitivities are presented with respect to the entire potential surface, as well as the individual Legendre components $V_n(r)$. The dynamical and kinetic observables studied were found to be most sensitive to the $V_2(r)$ term in the potential with the region of highest sensitivity dependent upon the energy or temperature as well as the states related by the individual observable. Sensitivity to the entire surface tends to show more structure due to interference among sensitivities to the individual components. While the main information on the underlying potential is retained, some information loss has been observed in the transition from the microscopic observables to the macroscopic ones.

34087 Measure of clustering in continuum percolation: Computer-simulation of the two-point cluster function. Lee, S. B. (Department of Mechanical and Aerospace Engineering, North Carolina State University, Raleigh, North Carolina 27695-7910(US)); Torquato, S. *Journal of Chemical Physics (USA)*, 91(2): 1173-1178 (15 Jul 1989).

The two-point cluster function $C_2(\mathbf{r}_1,\mathbf{r}_2)$ is determined for a D-dimensional interpenetrable-sphere continuum model from Monte Carlo simulations. $C_2(\mathbf{r}_1,\mathbf{r}_2)$ gives the probability of finding two points, at positions $\mathbf{r}_1$ and $\mathbf{r}_2$, in the same cluster of particles, and thus provides a measure of clustering in continuum-percolation systems. A pair of particles are said to be "connected" when they overlap. Results are reported for D=1,2, and 3 at selected values of the sphere number density ρ and of the impenetrability index λ, $0\leq\lambda\leq1$. The extreme limits λ=0 and 1 correspond, respectively, to the cases of fully penetrable spheres ("Swiss-cheese" model) and totally impenetrable spheres.

34088 Equations of state and gas–gas separation in soft-sphere mixtures. Kerley, G. I. (Sandia National Laboratories, Albuquerque, New Mexico 87185(US)). *Journal of Chemical Physics (USA)*, 91(2): 1204-1210 (15 Jul 1989). DOE Contract AC04-76DP00789.

The Monte Carlo method is used to compute equations of state for mixtures having intermolecular pair potentials of the form $u(r)=\epsilon(\sigma/r)^n$, where n=12 and n=6. Calculations are given for binary equimolar mixtures with additive diameters having the ratio σ_1/σ_2=3. In contrast to hard sphere mixtures, it is found that soft-sphere mixtures have a *positive* volume of mixing at high pressures. For the mixture with n=6, this effect leads to the separation of two *fluid* phases at a pressure that is below the freezing point of the larger component. These results show that, under certain conditions, large differences in molecular size are sufficient to cause this type of phase separation. The ideal mixing and van der Waals one-fluid (vdW1) theories are also discussed, and the predictions of these two models are compared with the Monte Carlo data. The vdW1 approximation gives satisfactory results at low pressures but is poorer than ideal mixing at high pressures.

34089 Diffusion coefficients in crosslinked polystyrene. Rothstein, D. (Kent State Univ., OH (USA)); Wu, B.G.; Madey, R.; Huang, J.C. *Separation Science and Technology (USA)*, 23(14-15): 2309-2317 (Nov-Dec 1988).

The authors measured the breakthrough curves for rectangular pulses of methane, ethane, and acetylene at low concentrations adsorbed on crosslinked polystyrene at 0, 25, and 30°C. The method of moments was utilized to evaluate the diffusion coefficients of the three gases based on a homogeneous-solid diffusion model.

34090 Carbon dioxide activation: thermodynamics of CO_2 binding and the involvement of two cobalt centers in the reduction of CO_2 by a cobalt(I) macrocycle. Fujita, E. (Brookhaven National Lab., Upton, NY (USA)); Szalda, D.J.; Creutz, C.; Sutin, N. *Journal of the American Chemical Society (USA)*, 110(14): 4870-4871 (6 Jul 1988). DOE Contract AC02-76CH00016.

The interaction of CO_2 with the cobalt (I) macrocycle, CoL^+ L = [14]diene = 5,7,7,12,14,14-hexamethyl-1,4,8,11-reversible binding of CO_2 to CoL^+ in CH_3CN as characterized by uv-visible spectroscopy, a CO_2 reduction in the solid state, of a binuclear species containing the Co-C(OH)-O-Co moiety are described in this article. 22 references, 2 figures.

4004 Electrochemistry

Refer also to citation(s) 33323, 33610, 33615, 33616, 33617, 33627, 33629, 33705, 33914, 33915, 33917, 33918, 33919, 34028, 34030, 34220

34091 The ferric-ferrous electron exchange. Friedman, H.L. (Dept. of Chemistry, State Univ. of New York, Stony Brook, NY (US)); Newton, M.D. v.v of Proceedings of the 1987 Electrochemical Society spring meeting: Extended abstracts. Volume 87-1. The Electrochemical Society, Pennington, NJ (1987). (CONF-870560–: 171. Electrochemical Society meeting, Philadelphia, Pennsylvania, USA, 10-15 May 1987).

The ferrous-ferric electron exchange in aqueous solution is one of the most completely studied reactions of this type. It is a challenge to see whether contemporary theoretical methods are powerful enough to elucidate the details of the process. Formulating the rate constant in terms of the spatial pair correlation functions enables certain thermodynamic data and data for certain nuclear spin relaxation processes to be brought to bear on the problem. This leads to a substantial improvement in the calculated ionic-strength-dependence of the rate constant, together with the surprising requirement that the ferrous ion-ferric ion separation in the important range for electron transfer involves shoulder in armpit interpenetration of the hydration shells. The effect is in agreement with recent neutron diffraction data for nickel chloride solutions.

34092 Kinetics of the ferrous/ferric electrode reaction in the absence of chloride catalysis. Nagy, Z. (Argonne National Lab., Argonne, IL (US)); Hung, N.C. v.v of Proceedings of the 1987 Electrochemical Society spring meeting: Extended abstracts. Volume 87-1. The Electrochemical Society, Pennington, NJ (1987). (CONF-870560–: 171. Electrochemical Society meeting, Philadelphia, Pennsylvania, USA, 10-15 May 1987).

The kinetics of the ferrous/ferric redox electrode reaction has been investigated by many workers as a simple, uncomplicated charge-transfer reaction, which seems ideal for testing experimental techniques and charge-transfer theories. However, it was not realized until very recently that minute traces of chloride can have a considerable effect on the reaction rate. The relation between the chloride content of the solution and the rate constant of the ferrous/ferric reaction on a gold electrode in 0.5 M perchloric acid solution was confirmed in the present work, using the potential step relaxation technique. The chloride-effect-free apparent standard rate constant was found to be 2.2×10^{-5} cms^{-1}, which is two to three orders of magnitude smaller than the rate constants normally reported for this reaction if the chloride content of the solution is not scrupulously controlled. These measurements were carried out by using in situ cleaning of the working electrode surface rather than extensive solution purification. Purification procedures are very time consuming, and may not be fully effective. Perchlorate ions can be cathodically reduced under certain conditions, consequently, trace

amounts of chloride ions, sufficient to increase the measured rate constant, can conceivably be generated in the cell after solution purification. Therefore, it seems desirable to develop methods to obtain chloride-free kinetic information in solutions containing traces of chloride by applying an in situ cleaning method to the measuring electrode surface immediately before the kinetic measurements. Two such methods were developed in the course of this work.

34093 Organic chemistry in ambient temperature chloroaluminate melts. Smith, G.P. (Oak Ridge National Lab., Oak Ridge, TN (US)); Zingg, S.P.; Dworkin, A.S. v.v of Proceedings of the Electrochemical Society Fall meeting: Extended abstracts. Volume 87-2. The Electrochemical Society, Pennington, NJ (1987). (CONF-871027–: 172. meeting of the Electrochemical Society, Honolulu, Hawaii, USA, 18-23 Oct 1987).

The authors are investigating the oxidation of 10H-phenothiazine (PTZ) and 10H-phenoxazine (POZ) in liquid mixtures of $AlCl_3$ and 1-ethyl-3-methyl-1H-imadozolium chloride (EMICl) at ambient temperatures. (The structures of PTZ and POZ are given at the end of this abstract.) Several aspects of this continuing investigation are described here. POZ and PTZ dissolve in either basic or acidic $AlCl_3$-EMICl mixtures to form stable solutions. Optical spectroscopy indicates that in basic mixtures these heterocycles are present as uncomplexed molecules while in acidic mixtures they interact strongly with the solvent. The authors interpret the latter in terms of sigma-bond formation between an acidic chloraluminate species, probably $AlCl_3$, and the lone-pair electrons on the heteroatoms of the organic substrates. This interaction can be reversed by neutralizing the melt with EMICl.

4005 Photochemistry

Refer also to citation(s) 34028, 34030, 34095

34094 (DOE/ER/01198–T14, pp. 525-546) **Advanced microstructures for photochemical and electrochemical energy conversion.** Faulkner, L.R. Illinois Univ., Urbana, IL (USA). Materials Research Lab. Mar 1988. In *Materials Research Laboratory: Renewal proposal for the extension in time and funds.* Order Number DE88013776/JAW. Available from NTIS, PC A99/MF A01; 1.

Photochemistry can be driven by light collected in one spatial region and transmitted by exciton diffusion to a special photoreaction site elsewhere. This project focuses particularly on structures that can collect photons over a sizable domain and funnel the energy to a tailored reaction center, where the energy can be used. The work concentrates (a) on the rules for effective transfer of energy, (b) on the design of effective molecular components and supermolecular structures for light collection, and (c) on the ways in which light-collecting arrays can be joined to reaction centers that are chemically accessible. The project deals more generally with new ways of organizing molecules in space. The materials of concern are mainly molecular solids, polymers and inorganic oxides. A significant new direction of research concerns the use of proteins as templating agents. Diffusion and collection of excitons is explored by steady-state and time-resolved fluorescence spectroscopy. Some electrochemical methods are used in the synthesis and characterization of new structures.

4006 Radiation Chemistry

Refer also to citation(s) 33339, 33350, 33351, 33352, 33385, 34520, 34522, 34663, 34674

34095 (DOE/ER/13404–4) **The contribution of electronically excited states to the radiation chemistry of organic systems: Progress report, June 30, 1988–April 30, 1989.** Lipsky, S. Minnesota Univ., Minneapolis, MN (USA). Dept. of Chemistry. [1989]. 12p. Sponsored by DOE Energy Research. DOE Contract FG02-85ER13404. Order Number DE89013111/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The photoionization current from anthracene in liquid hydrocarbons has been studied as a function of excitation energy. From the dependence of the photocurrent spectrum on the magnitude of an externally applied electric field, it is deduced that the appearance of a fine structure in these spectra is mainly attributable, not to variability in the electron yield probability as others have conjectured, but rather to an energy dependence of the electron's thermalization range parameter. Solvent effects on the diffuseness of this structure are also explainable on this basis. By monitoring the fluorescence from hexafluorobenzene dissolved in the non-fluorescent hydrocarbon solvents, 2,3,4-trimethylpentane, 2,2-dimethylbutane, cyclopentane and tetramethylsilane excited with β^- particles, it has been possible to extract the geminate ion-pair scavenging probability, $p^\dagger$. This is found to have a dependence on hexafluorobenzene concentration, c, entirely similar to what has previously been reported for $p^\dagger$ extracted from quenching of solvent fluorescence by perfluorocarbon scavengers. Thus it is now demonstrated that two different fluorescent techniques provide an expression for $p^\dagger$ that is distinctly disparate from that initially introduced by Warman, Asmus and Schuler to explain their results on chemical scavengers. Origins for this difference are considered. Preliminary attempts to locate a triplet-state emission from saturated hydrocarbons excited biphotonically with 307 nm XeCl excimer laser light have thus far been unsuccessful. 15 refs.

34096 (IAEA-TECDOC–486, pp. 95-111) **Radiation gelation of hydrogels and their applications.** Rosiak, J. (Technical Univ. of Lodz (Poland). Inst. of Applied Radiation Chemistry); Olejniczak, J.; Rucinska-Rybus, A.; Galant, S.; Burczak, K.; Pekala, W. International Atomic Energy Agency, Vienna (Austria). Dec 1988. (CONF-8706397–: Final research co-ordination meeting on application of radiation technology in immobilization of bioactive materials, Beijing, China, 15-18 Jun 1987). In *Radiation technology for immobilization of bioactive materials. Proceedings of the final research co-ordination meeting held in Beijing, 15-18 June 1987.* Order Number DE89617908/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

In the report the results of studies on the application of radiation technique to the production of biomaterials such as vascular prostheses with increased hydrophilicity and improved tightness, a special type of ocular insert device containing the drug against glaucoma as well as different kinds of wound covering materials have been presented. These materials have been obtained on the base of radiation crosslinked synthetic polymers. As source materials appropriate aqueous solutions of monomers were used. In the first part of this report the results concerning the radiation polymerization and crosslinking of N-vinylpyrrolidone in aqueous solutions in the presence of different additives (O_2, N_2O, CH_3OH) are presented. (author). 19 refs, 11 figs.

4007 Radiochemistry and Nuclear Chemistry

Refer also to citation(s) 33564, 33943, 34061, 34351, 34622

34097 (ARL/TR–079) **Results of the quality assurance testing programme for radiopharmaceuticals 1984-1985.** Bonnyman, J.; Lauder, R.; Van Every, B. Australian Radiation Lab., Melbourne (Australia). Nov 1987. 45p. Order Number DE89619493/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The Australian Radiation Laboratory conducts a Radiopharmaceutical Quality Assurance Test Programme in which radiopharmaceuticals used in nuclear medicine in Australia are tested for compliance with specifications. Samples obtained for testing were obtained through normal commercial channels. All technetium-99m cold kits were reconstituted according to the directions in the package insert using sodium pertechnetate (^{99m}Tc) B.P. The results of testing during 1984 and 1985 are summarised. Overall, 215 batches of 28 different types of radiopharmaceutical were tested in 1984-5. Failure to meet full specifications was observed in 26 of the 215 batches of radiopharmaceuticals tested (12.0%). Labelling errors were observed in 14 of the 26 batches failing specifications and was solely responsible for the failure of the product on 13 of these occasions. Most other failures were due to either the incorrect radionuclide activity being provided or the radiochemical purity being less than that required in the specifications. A section has also been included on the technetium-99 content of the sodium pertechnetate (^{99}Tc) injection. These results indicate that technetium-99 levels vary over a wide range and are present at

about 7-8 times the level found in the fresh eluate from a chromatographic generator. At present, there is no specification for permissible levels of technetium-99. Users, however, should be aware of the effects of these increased levels in some labelling applications e.g. blood cells or monoclonal antibodies.

34098 Volatility of cesium and strontium from a synthetic basalt. Sill, C.W. (Idaho National Engineering Lab., EG and G Idaho, Inc., Idaho Falls, ID (US)). *Nuclear and Chemical Waste Management (USA)*, 8(2): 97-106 (1988).

The volatility of cesium from a calcined mixture of oxides containing 1% cesium as the chloride and 1 μCi of cesium-137 tracer follows a logarithmic relationship with temperature from 0.067 $\pm$ 0.002% volatilized per hour at 400^{0}C to 22.67 $\pm$ 0.09% per hour at 900^{0}C of that present. At the same rate, complete volatilization would occur in 1 hour at 1030^{0}C, but only 0.0020% will be volatilized per hour at 100^{0}C. After fusion has occurred, the volatility of cesium decreases markedly, probably because of the limited rate of diffusion through the viscous melt to the surface without stirring. The rate varied from about 0.059 $\pm$ 0.001% per hour at 1300^{0}C to 0.316 $\pm$ 0.002% per hour at 1500^{0}C. Volatilization of strontium could not be detected at any temperature used in the presence of 1% strontium and 1 μCi of strontium-85 tracer with a detection limit of about 0.03% per hour. Volatilization of carrier-free cesium-137 tracer evaporated on a polished stainless steel plate was about 40% in the first minute when the plate was heated over a blast lamp to a bright red color, probably about 900^{0}C. After subsequent heatings, the volatility decreased rapidly to about 0.4% per minute after 39 minutes with a total loss of only 75% in 69 min.

4008 Combustion, Pyrolysis, and High-temperature Chemistry

Refer also to citation(s) 33892

34099 (DFVLR-FB--89-02) **Theoretical investigation of diffusion flame stabilization over a recirculating flow.** Konczalla, M. Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Koeln (Germany, F.R.); Bielefeld Univ. (Germany, F.R.). Fakultaet fuer Physik. 1989. 124p. (In German). Order Number DE89783263/JAW. Available from NTIS (US Sales Only), PC A06/MF A01;1.

A flame fixed to a stabilizing device results from the interaction of transport processes and an exothermic chemical reaction. The stabilization of a diffusion flame over a recirculating flow downstream of a backward-facing step is investigated. Special features of this flow are taken into account. An Arrhenius expression is introduced into the conservation equations to describe the reaction. The activation energy of the reaction is used as large parameter in a singular perturbation approach. A well-defined singularity determines an ignition point on the dividing streamline. Downstream from this ignition point a flame is observed. Using Linan's premixed flame analysis, an equation for the flame surface is derived. It is shown that only up to a well-defined value of the entrance velocity the flame penetrates the mixing layer over the wake. (orig.) With 28 figs., 53 refs.

34100 (TKK-KO/ET--31) **Effect of pressure on fluidized bed behaviour.** Horvath, A. Helsinki Univ. of Technology, Otaniemi (Finland). Inst. of Energy Engineering. 1989. 63p. Order Number DE89776168/JAW. Available from NTIS (US Sales Only), PC A04/MF A01;1.

At the Helsinki University of Technology in the Laboratory of Energy Economics and Power Plants pressurized fluidized bed technology is currently researched. For purposes a PFBC test rig was built in cooperation between Helsinki University of Technology, the Technical Research Centre of Finland and Imatran Voima. The reactor of the test-rig has 0.15 m inside diameter and it can be operated at a pressure up to 1 MPa. As a subproject of the wide research program, financed by the Ministry of Trade and Industry of Finland, the effect of pressure on the fluid mechanical behaviour of the fluidized bed is investigated on the test-rig. Present report surveis the results of former research works, dealing with the fluid mechanical properties of pressurized fluidized systems. It reviews and compares measuring methods developed to examine the properties of bubbles in the fluidized bed. The report gives an account of the measurements done at the Helsinki University of Technology in the period 1987-88 (first period). The measurements were done on the PFBC test rig under cold conditions and during combustion tests using different measuring methods. The first test period aimed to start up with the research of fluid mechanics and to test measuring systems.

34101 Experimental studies of flame passage time frequencies in turbulent premixed conical flames. Cheng, R.K. (Lawrence Berkeley Lab., Berkeley, CA (US)); Shepherd, I.G.; Gokalp, I.; Boukhalfa, A. v.v of The Combustion Institute joint conference: Western states and Japanese sections (Extended Abstracts). Combustion Institute, Pittsburgh, PA (1988). (CONF-871118--: Combustion Institute joint fall meeting: Western states and Japanese sections, Honolulu, Hawaii, USA, 22-25 Nov 1987).

Although there have been many experimental and theoretical studies of premixed turbulent flame propagation, the functional relationship between turbulent intensity and mean reaction rate is still not well understood. The use of the turbulent burning speed concept to correlate the increase in burning rate with turbulence intensity has not been very successful. One possible reason is that this concept only considers time mean statistical parameters which may not be sufficient to fully characterize the dynamics of the turbulent flame. With the developments of recent theoretical models which place more emphasis on the temporal behavior of the scalar and velocity fluctuations there is much interest in measurements of these parameters in experiments. The experimental results would be useful to aid in the development of turbulent combustion theory and to infer the physics of the interaction processes which control the overall combustion reaction rate. The use of flame passage time frequencies to model the reaction rate was developed. Central to these models is a theoretical description of the time and length scales of the scalar field from a generalization to a two-point, two time formulation of their previous combustion models. These scales are proportional to the frequency at which a flame front crosses any point within the turbulent flame brush and hence, in the flamelet regime, the reaction rate at that point since each passage of the flamelet represents conversion from reactants to products.

34102 Further characterization of turbulent premixed flames stabilized in a stagnation flow. Cho, P. (Univ. of California, Davis, CA (US)); Law, C.K.; Cheng, R.K. v.v of The Combustion Institute joint conference: Western states and Japanese sections (Extended Abstracts). Combustion Institute, Pittsburgh, PA (1988). (CONF-871118--: Combustion Institute joint fall meeting: Western states and Japanese sections, Honolulu, Hawaii, USA, 22-25 Nov 1987).

The authors have proposed a stagnation flow configuration for the study of premixed turbulent flames. The stability of the turbulent flame in the divergent stagnation flow is achieved at a particular location where the mean velocity balances the turbulent flame speed. The resulting flame is planar, locally-normal to the upstream approach flow (at the center line), and does not depend on recirculation for stabilization. This configuration is, thus, the closest experimental approximation of the idealized one dimensional flame assumed by many theoretical models. Furthermore, the turbulence intensity in a nonreacting flow is found to be isotropic and constant downstream of the nozzle exit. In addition, the turbulent flame speeds, S_T, can be unambiguously determined from the mean velocity profiles and the values of S_T so determined correlate well with the turbulence intensity.

34103 Formation and destruction of nitrous oxide in lean, premixed combustion. Martin, R.J. (Lawrence Berkeley Lab., Berkeley, CA (US)); Brown, N.J. v.v of The Combustion Institute joint conference: Western states and Japanese sections (Extended Abstracts). Combustion Institute, Pittsburgh, PA (1988). (CONF-871118--: Combustion Institute joint fall meeting: Western states and Japanese sections, Honolulu, Hawaii, USA, 22-25 Nov 1987).

Nitrous Oxide (N_2O) is the principle source of stratospheric nitric oxide, which, in turn, is a major scavenger of stratospheric ozone. N_2O affects the earth's radiation balance and is a greenhouse gas since it absorbs strongly in the infrared. Nitrous oxide concentration in the atmosphere is increasing at the rate of 0.2% per year, and combustion is a major contributor to the nitrous oxide budget, but the actual quantification of this is difficult to evaluate since there is an extremely small data base. Despite its importance, the factors

which control N_2O emissions are not well understood. In order to develop a more fundamental understanding of N_2O combustion chemistry experiments were conducted on premixed flames, and compared to a chemical kinetic model.

34104 Diffusional/thermal coupling and intrinsic instability of solid propellant combustion. Margolis, S.B. (Sandia Nat. Labs., Livermore, CA (US)); Williams, F.A. v.v of The Combustion Institute joint conference: Western states and Japanese sections (Extended Abstracts). Combustion Institute, Pittsburgh, PA (1988). (CONF-871118–: Combustion Institute joint fall meeting: Western states and Japanese sections, Honolulu, Hawaii, USA, 22-25 Nov 1987).

Intrinsic instability in the steady, planar deflagration of a homogeneous solid propellant is considered through an asymptotic analysis for large values of nondimensional overall activation energies for the surface pyrolysis and gas-phase combustion processes. It is shown that the previously known pulsating instability is essentially connected with condensed-phase pyrolysis, and that new instability phenomena, which are associated with intrinsic gas-flame instability and which are sensitive to the value of the gas-phase Lewis number and to the distance of the gas flame from the propellant surface, arise. These results are obtained by relaxing the usual assumptions of quasi-steadiness and quasi-planarity for the gas phase, so that the coupling of intrinsic diffusional/thermal instabilities in the gas and solid phases becomes an integral feature of the model. The steady, planar deflagration thus may be unstable not only to pulsating disturbances, but also to (time-independent, nonplanar) cellular perturbations as well. It is shown that the onset of pulsating instability has a dual character which is related to the intrinsic instabilities of both the deflagrating solid and the gas flame. In contrast, the onset of cellular instability, apparently not predicted by previous theories for solid propellants, is clearly related to the stability of the gas flame. Appropriate limiting cases of the model retrieve the well-known pulsating and cellular neutral stability boundaries for strictly gaseous combustion, and the pulsating neutral stability boundary for strictly condensed phase combustion.

34105 Theoretical studies of the chemical reactions involved in the ignition of nitramines. Melius, C.F. (Sandia Nat. Labs., Livermore, CA (US)). v.v of The Combustion Institute joint conference: Western states and Japanese sections (Extended Abstracts). Combustion Institute, Pittsburgh, PA (1988). (CONF-871118–: Combustion Institute joint fall meeting: Western states and Japanese sections, Honolulu, Hawaii, USA, 22-25 Nov 1987).

The ignition of RDX has been studied theoretically by solving the time-dependent nonlinear coupled differential equations for temperature and species mass fractions. Initial temperatures ranged from 500K to 1400K. Initial pressures from 1 to 100 atmospheres were investigated. The results indicate that the ignition process is complex, occurring in two stages. The first stage involves an ignition delay followed by a small temperature rise, resulting from the conversion of weakly-bound hydrogen (e.g., in CH_2O and HONO) to H_2O. The second stage involves a second delay time in which the NO_2 is converted NO followed by a large temperature rise. While the first ignition time decreases monotonically with starting temperature, the second ignition time initially increases with increasing temperature and then decreases. This result is a consequence of the change in RDX decomposition mechanism with temperature. The temperature rise during the first stage ignition first decreases monotonically with temperature and then turns over and increases with increasing initial temperature. At the higher temperatures, the initial decomposition processes leads to a drop in temperature before the first ignition stage occurs. The chemical reactions occurring for each of the stages of ignition are discussed.

34106 Numerical simulation of turbulent premixed combustion and decay of turbulent swirling flow. Cloutman, L.D. (Lawrence Livermore Nat. Lab., Livermore, CA (US)). v.v of The Combustion Institute joint conference: Western states and Japanese sections (Extended Abstracts). Combustion Institute, Pittsburgh, PA (1988). (CONF-871118–: Combustion Institute joint fall meeting: Western states and Japanese sections, Honolulu, Hawaii, USA, 22-25 Nov 1987).

In recent years multidimensional numerical models have been developed to predict reacting flows in a wide variety of combustion systems. These models must be validated by comparing them to experimental results. This paper presents three numerical simulations using the KIVA and CONCHAS/SPRAY hydrodynamics programs. The KIVA program produces numerical solutions of the full nonlinear, transient, compressible flow, Navier-Stokes equations in two and three dimensions, including moving boundaries, chemical reactions, and turbulence models. The numerical algorithm is based on the arbitrary Lagrangian-Eulerian (ALE) technique. CONCHAS-SPRAY is the two-dimensional ICED-ALE program that was extended to produce KIVA.

34107 The simulation of some turbulent combustion processes using an acoustically driven burner. Linevsky, M.J. (The Johns Hopkins Univ., Laurel, MD (US)); Fristrom, R.M.; Smith, J.R. v.v of The Combustion Institute joint conference: Western states and Japanese sections (Extended Abstracts). Combustion Institute, Pittsburgh, PA (1988). (CONF-871118–: Combustion Institute joint fall meeting: Western states and Japanese sections, Honolulu, Hawaii, USA, 22-25 Nov 1987).

The coherent structure of flow disturbances has recently been of much interest and in this study an acoustically-driven burner has been developed which is capable of simulating such structures in premixed jet flames. A particularly straightforward formulation of turbulent combustion based on the wrinkled flame front model. The acoustic burner technique appears to be well suited for providing information useful in the corroboration of this theory. The authors feel that the results provide a useful insight into the behavior of flame fronts in the presence of flow disturbance and help establish the applicability of the wrinkled flame front model to turbulent premixed flames. This information should prove useful in modeling of turbulent combustion.

34108 Free-radical oxidation of isocyanic acid. Perry, R.A. (Sandia Nat. Labs., Livermore, CA (US)); Tully, P.; Allendorf, M.D. v.v of The Combustion Institute joint conference: Western states and Japanese sections (Extended Abstracts). Combustion Institute, Pittsburgh, PA (1988). (CONF-871118–: Combustion Institute joint fall meeting: Western states and Japanese sections, Honolulu, Hawaii, USA, 22-25 Nov 1987).

Laser-based kinetic studies of the reactions $O(^3P) + HNCO \rightarrow$ Products and $OH + HNCO \rightarrow$ Products are described. The kinetic results may be represented by the Arrhenius expressions $\kappa_1(T) = 5.4 \times 10^{-12} \exp[-10.3 \text{ kcal mol}^{-1}/RT] \text{ cm}^3 \text{ molecule}^{-1} \text{ s}^{-1}$ and $\kappa_2(T) = (4.4 \pm 0.9) \times 10^{-12} \exp[(5.54 \pm .28) \text{ kcal mol}^{-1}/RT] \text{ cm}^3 \text{ molecule}^{-1} \text{ s}^{-1}$. The mechanistic implications of these results on the $RAPRENO_x$ process are discussed.

34109 Role of methoxy radicals in combustion. Oldenborg, R.C. (Los Alamos Nat. Lab., Los Alamos, NM (US)); Wantuck, P.J.; Baughcum, S.L. v.v of The Combustion Institute joint conference: Western states and Japanese sections (Extended Abstracts). Combustion Institute, Pittsburgh, PA (1988). (CONF-871118–: Combustion Institute joint fall meeting: Western states and Japanese sections, Honolulu, Hawaii, USA, 22-25 Nov 1987).

Methoxy removal rate constants have recently been measured for collisions with CH_4, O_2, CO, Ar, N_2, Xe, and CF_4 in the temperature range 298 - 973K using a laser photolysis/laser-induced fluorescence technique. The results of these measurements are reviewed and a procedure for deconvoluting the contribution due to reaction from thermally induced decomposition and isomerization are presented. Based on this analysis, it is concluded that at temperatures above 1500K most of the CH_3O is removed through collision-induced decomposition and/or isomerization, with less than 10% to the total CH_3O removal rate is due to abstraction and/or hydrogen donor reactions.

34110 Pulse combustion. Keller, J.O. (Sandia Nat. Labs., Livermore, CA (US)); Bramlette, T.T.; Westbrook, C.K.; Dec, J.E. v.v of The Combustion Institute joint conference: Western states and Japanese sections (Extended Abstracts). Combustion Institute, Pittsburgh, PA (1988). (CONF-871118–: Combustion Institute joint fall meeting: Western states and Japanese sections, Honolulu, Hawaii, USA, 22-25 Nov 1987).

It is known that the timing of the energy release with respect to the resonant pressure wave is critical in maintaining proper resonance in a pulse combustor. In earlier work, the concept of individual characteristic delay times was established and noted that

these times contribute nearly independently to a total ignition delay time. It is through this contribution to this total delay time that the individual delay times affect the phase relationship between the instantaneous energy release rate and the resonant pressure wave and hence the operation of the pulse combustor. The relative and absolute magnitude of these individual characteristic times must be quantified before widespread application of this knowledge can be realized. In this study individual characteristic delay times were calculated from a fluid dynamic mixing model and a chemical kinetics model. These predicted times were then compared with experimentally measured values of the total ignition delay time of a gas-fired pulse combustor for a wide range of fluid dynamic mixing times and homogeneous chemical ignition delay times.

34111 Pulse combustion. Keller, J.O. (Sandia National Labs., Livermore, CA (US)); Bramlette, T.T.; Dec, J.E.; Westbrook, C.K. *Combustion and Flame (USA)*, 75(1): 33-44 (Jan 1989).

The response of a valved pulse combustor to changes in the relative timing between the resonant pressure wave and the instantaneous energy release rate has been examined. Experiments were designed to examine the pulse combustor's response to independent changes in the experimental conditions that resulted in nearly independent changes in the fluid dynamic species mixing time, the fluid dynamic mixing time of cold reactants with hot products, the characteristic chemical kinetics time, and the characteristic resonance time. The time scales considered in this study were adjusted independently to modify the coupling between the instantaneous energy release rate and the resonant pressure wave, thereby modifying the magnitude of the pressure oscillations and altering the frequency of operation. All of these experimental observations of the pulse combustor response to variations in characteristic time scales are interpreted in terms of Rayleigh's criterion.

34112 Cylindrical premixed laminar flames. Libby, P.A. (Univ. of California at San Diego, La Jolla, CA (US)); Peters, N.; Williams, F.A. *Combustion and Flame (USA)*, 75(3): 265-280 (Mar 1989).

Activation energy asymptotics are used to analyze the structure and extinction characteristics of a premixed flame in a right circular cylinder enclosing a stretching vortex line. Effects of variable density and of Lewis numbers that differ from unity are taken into account for a one-reactant system with one-step, Arrhenius chemistry. It is shown that the circulation of the vortex does not influence the flame structure, but that the stretch of the vortex alters the structure and the extinction characteristics of the flame, characteristics that involve inter alia abrupt extinction for suitably large rates of stretch at finite radii for all Lewis numbers.

34113 Linear-eddy modeling of turbulent transport. II. Kerstein, A.R. (Sandia National Labs., Livermore, CA (US)). *Combustion and Flame (USA)*, 75(3): 397-414 (Mar 1989).

The linear-eddy modeling approach involves the representation of a spatially developing flow by a simulation of the time development along a transverse line moving with the mean flow. Scalar quantities evolve by Fickian (molecular) diffusion and by randomly occurring spatial rearrangements, representing turbulent convection. A formulation introduced previously, the block-inversion model, is adapted here for application to turbulent planar shear layer mixing. Predictions of the mixing and chemical reaction rate dependence on Reynolds, Schmidt, and Dankoehler numbers, and of the spatially resolved probability density function (pdf) of the concentration field, are consistent with measurements and suggest a simple parameter dependence governing mixing and reaction. The mixed fluid peak of the simulate pdf occurs at a concentration that does not depend on spatial location, as found experimentally. The simulations suggest a simple explanation for the difference between this behavior and observations in the thermal mixing layer in grid turbulence.

42 ENGINEERING

4202 Facilities and Equipment

Refer also to citation(s) 33161, 33163, 33227, 33307, 33318, 33319, 33320, 33322, 33323, 33533, 33805, 33963, 34150, 34174, 34935, 35246, 35448, 35465

34114 (AD-A-201303/5/XAB) **Quantum limits of superconducting heterodyne receivers. Final report, 15 May 1986-14 May 1988.** Richards, P.L. California Univ., Davis, CA (USA). Dept. of Physics. 23 Sep 1988. 12p. Available from NTIS, PC A03/MF A01.

An investigation of the behavior of superconducting heterodyne receivers in the quantum limit can be carried out using very low leakage tunnel junctions and relatively low frequencies, such as W-band. Alternatively, very low capacitance small-area junctions with moderate leakage can be used at much higher frequencies. It is necessary in either case to make precise measurements of mixer noise and gain. It is also essential to make precise determinations of the embedding admittances in order to permit comparison between experiment and theory. In addition, extensive computer software must be written in order to carry out the comparisons with quantum mixer theory. In this project, the technology has been developed for both approaches to the study of the quantum limits of SIS heterodyne mixers. All of the factors necessary to make these comparisons in a W-band waveguide mixer have been in place since early 1977. Due to delays in the production at Yale of the special low leakage tunnel junctions required, however, the measurements were postponed until late 1988.

34115 (AD-A-201400/9/XAB) **Superconductivity: recent developments and defence applications.** MacPherson, R.W. Department of National Defence, Ottawa, ON (Canada). Research and Development Branch. 11 Mar 1988. 31p. (CRAD-1/88). Available from NTIS, PC A03/MF A01.

Abstract in French.

The recent advances in superconductivity have led to much speculation about the possible applications of the new technology to all walks of life. In an attempt to determine what defence applications have realistic expectations of coming to fruition, a number of opinions solicited from defence scientists is summarized and reviewed along with information obtained from selected journal and magazine articles.

34116 (AD-A-204532/6/XAB) **Composite ceramic superconducting wires for electric-motor applications. Quarterly report No. 2, 30 September-30 December 1988.** Halloran, J.W. Ceramics Process Systems Corp., Cambridge, MA (USA). 30 Dec 1988. 185p. Available from NTIS, PC A09/MF A01.

This is the Second Quarterly report on a project to develop HTSC wire for an HTSC motor. The raw material for fiber production is an improved $YBa_2Cu_3O(7-x)$ powder. Continuous spools of green $YBa_2Cu_3O(7-x)$ fiber are being produced. The major effort in fiber spinning is aimed at improving fiber quality and reducing fiber. Binder burnout and sintering has been intensively investigated. Fiber sintering fibers is done by the rapid zone sintering method. A continuous furnace received near the end of this Quarter will be used for continuous sintering. Continuous silver-coated green fiber is produced. Progress was made toward continuous cladding using the mechanical cladding concept. The melt spinning process was successfully applied to $YBa_2Cu_3O(7-x)$ powders at 50 vol% solids loadings. The cladding work centered on mechanical cladding of silver-treated filaments by solder bonding to copper strips. Aluminum deposits on $YBa_2Cu_3O(7-x)$ filament surfaces were produced by MOCVD at ATM, but the superconductivity was degraded. Electrical characterization work focused on methods of making low-resistance contacts on $YBa_2Cu_3O(7-x)$ filaments. Emerson Motor Division has begun work on DC heteropolar and homopolar motor designs. The mechanical stresses on conventional copper wires during winding were characterized to determine the mechanical parameters of motor building.

34117 (CONF-880736-6) **Design and operation of a horizontal liquid helium flow facility.** Van Sciver, S.W.; Wiesend, J.G. II. Wisconsin Univ., Madison, WI (USA). 1988. 6p. Sponsored by DOE Energy Research. DOE Contract AC02-86ER40306. From 12. international cryogenic engineering conference and exhibition; Southampton, UK; 12-15 Jul 1988. Order Number DE89013482/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The University of Wisconsin horizontal liquid helium flow facility (LHFF) consists of a five meter long 20 cm ID horizontal dewar connected to two end boxes. Several heat exchanger inserts have been built to allow variable temperature operation of 1.6 K $\leq$ T $\leq$

4.2 K. A centrifugal pump is installed at one end of the facility permitting experiments in forced flow liquid helium up to 100 gm/s. The horizontal design allows experimentation on long straight test sections which may be used either to study fundamental properties of heat and mass transfer in helium or prototype cryogenic components under realistic conditions. A detailed description of the design and operating experience of the LHFF is presented. 5 refs., 5 figs.

34118 (CONF-890721–5) **Research in autonomous robotics at ORNL using HERMIES-III.** Weisbin, C.R.; Burks, B.L.; Einstein, J.R.; Feezell, R.R.; Manges, W.W.; Thompson, D.H. Oak Ridge National Lab., TN (USA). 1989. 19p. Sponsored by DOE Energy Research. DOE Contract AC05-84OR21400. From Joint ASME/JSME pressure vessel and piping conference; Honolulu, Hawaii, USA; 23-27 Jul 1989. Order Number DE89004933/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

HERMIES-III is an autonomous robot comprised of a seven degree-of- freedom (DOF) manipulator designed for human scale tasks, a laser range finder, a sonar array, an omnidirectional wheel-driven chassis, multiple cameras, and a dual computer system containing a 16-node hypercube expandable to 128 nodes. The current experimental program involves performance of human-scale tasks (e.g., valve manipulation, use of tools), integration of a dexterous manipulator and platform motion in geometrically complex environments, and effective use of multiple cooperating robots (HERMIES-IIB and HERMIES-III). The environment in which the robots operate has been designed to include multiple valves, pipes, meters, obstacles on the floor, valves occluded from view, and multiple paths of differing navigation complexity. The ongoing research program supports the development of autonomous capability for HERMIES-IIB and III to perform complex navigation and manipulation under time constraints, while dealing with imprecise sensory information. 10 refs., 4 figs.

34119 (DOE/ER/13396–T1) **Strategies for optimal plant redesign in a changing environment: Annual report, 1988–1989.** Carnegie-Mellon Univ., Pittsburgh, PA (USA). 1989. 12p. Sponsored by DOE Energy Research. DOE Contract FG02-85ER13396. Order Number DE89014653/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

In this section we will give a brief overview of the major results that we have accomplished in the following areas: retrofit of separation systems for existing or new conditions; energy retrofit design of heat exchanger networks; debottleneck retrofit of process flowsheets with mixed configuration; large scale nonlinear programming methods; retrofit to improve process flexibility; retrofit to improve process controllability; and long range planning models.

34120 (DOE/NV/10322–36) **Lithology and stratigraphy of drill holes completed during 1988 in LANL [Los Alamos National Laboratory] use areas of Yucca Flat, Nevada Test Site, Volume 10: Geologic report.** Drellack, S.L. Jr.; Thompson, P.H.; Rayburn, C.J. Fenix and Scisson, Inc., Mercury, NV (USA). Mar 1989. 53p. Sponsored by DOE Defense Programs. DOE Contract AC08-84NV10322. Order Number DE89013217/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

This report is a compilation of data from drill holes completed during calendar year 1988 in areas used by Los Alamos National Laboratory in Yucca Flat, Nevada Test Site. Data presented include: Hole locations and other pertinent physical data; lithologic descriptions and stratigraphy for each hole; a graphic presentation for each hole (except UE-3e No. 3 and U-4u No. 1) illustrating lithology, stratigraphy and the corresponding response of selected geophysical logs; and supplemental data relevant to each drill hole. Lithologic descriptions and stratigraphic identification of Tertiary volcanic rocks are emphasized. 25 refs., 4 figs., 2 tabs.

34121 (GRS–70) **Analytical evaluation of special numerical calculations of pressure waves in the fluid. Pt. 1. One-dimensional wave propagation.** Drittler, K. Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Garching (Germany, F.R.). Feb 1989. 82p. (In German). Order Number DE89783262/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

The practise of applying control calculations to the results of extensive numerical calculations in the field of scientific engineering is indispensable, especially with regard to safety assessments. Analytical methods are often best suited for this purpose. Furthermore, they allow developing a sound understanding of the physical processes involved. This also applies to several methods for determining the pressure behavior inside a fluid. In the present report, the results of calculations are checked by the method of the so-called one-dimensional wave propagation. It is presumed that the propagation of the pressure wave in a fluid-filled system can be closely approximated by a function which, in addition to time and other parameters depends only on the coordinate of the direction of wave propagation. Satisfactory approximations are obtained wherever the averaging of certain parameters in the direction perpendicular to the direction of propagation is sufficient with regard to the mathematical evaluation of essential effects. The examples presented in this report start with approximative descriptions of nonlinear effects in pressure waves. Starting from a certain location and point in time, the pressure waves have a linear characteristic. This is because pressure pulses introduced into the fluid are usually dampened to a considerable extent. Going backward in time, perturbation calculations can then be carried out. Certain aspects of the resulting approximation are well suited to check the results of extensive numerical calculations. The comparisons presented show good to reasonable results.

34122 (INIS-mf–11454) **Cryogenics '88.** Ceskoslovenska Vedeckotechnicka Spolecnost, Usti nad Labem (Czechoslovakia). Dum Techniky. Apr 1988. 218p. (In English, Czech, Slovak, Ru (CONF-8804279–: Cryogenics '88, Usti nad Labem, Czechoslovakia, 19-21 Apr 1988). Order Number DE89617941/JAW. Available from NTIS (US Sales Only), PC A10/MF A01 - OSTI; INIS.

The proceedings has four chapters: Processes and apparatus of low-temperature installations, Superconductors and magnets, Gas separators, Helium liquefiers and cryostats. It contains a total of 56 papers of which 4 belong in the INIS scope. (J.B.).

34123 (K/SS–528) **Rupture testing of UF_6 transport and storage cylinders.** Ziehlke, K.T.; Barlow, C.R. Oak Ridge Gaseous Diffusion Plant, TN (USA). 1989. 6p. Sponsored by DOE Nuclear Energy. DOE Contract AC05-84OT21400. (CONF-890631–50: International symposium on packaging and transporting of radioactive materials, Washington, D.C., USA, 11-16 Jun 1989). Order Number DE89013773/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Large steel cylinders for shipment and storage of uranium hexafluoride have been in production since about 1951, in support of the United States Department of Energy (DOE) programs for nuclear fuel enrichment services. These 48-inch diameter cylinders, in 10- and 14-ton capacities and intended for use with feed, tails, and low enrichment U-235 intermediate product, have been purchased in several minor design variations and comprise about 46,500 cylinders at the present time. In addition, DOE's uranium enrichment operations own a large number of smaller product cylinders: more than 3,000 type 30A steel cylinders, about 1,650 5-, 8-, and 12-inch product cylinders made of nickel and Monel, and about 2,000 small sample cylinders of nickel and Monel. The total number of UF_6 containers in world-wide distribution is unknown but must number well in excess of 100,000 units. Handling accidents, such as the damaged cylinders from the Monte Louis, the Portsmouth, and Kerr-McGee incidents, and many other handling and transport accidents of lesser consequence, along with governmental policies and industrial practices which have a bearing on long-term storage of feed or processes materials all raise proper concerns about the ability of these cylinders to safely contain uranium hexafluoride. In addition to being designed, built, and maintained to national code standards, the cylinder designs have been subjected to burst tests over the past several years. This paper reviews and updates the results of these tests. 1 ref., 1 tab.

34124 (KURRI-TR–305, pp. 45-46) **Research on criticality safety using the Nuclear Fuel Cycle Engineering Research Facility (NUCEF).** Kobayashi, Iwao (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst. Jul 1988. (In Japanese). (CONF-8711251–: Seminar on reactor physics experiments with critical assemblies, Kyoto, Japan, 26 Nov 1987). In *Proceedings of the seminar on reactor physics experiments with*

critical assemblies. Order Number DE89003363/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

CRITICALITY/reactor safety experiments; REACTOR EXPERIMENTAL FACILITIES/criticality; CRITICALITY; PLANNING; PLUTONIUM; SLIGHTLY ENRICHED URANIUM; NEUTRON SPECTRA; NEUTRON LEAKAGE; TRANSIENTS; FISSION PRODUCT RELEASE

34125 (LA-UR-89-5) **Dynamic plastic buckling of spherical shells during collapse.** Duffey, T.A. Los Alamos National Lab., NM (USA). 1989. 21p. Sponsored by DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-890721-8: Joint ASME/JSME pressure vessel and piping conference, Honolulu, Hawaii, USA, 23-27 Jul 1989). Order Number DE89006543/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Conditions are established that lead to the growth of initial displacement imperfections (buckling) of complete spherical shells during significant inward motion. This preliminary study is limited to axisymmetric buckling modes only. Shell thickening during inward motion is taken into account, and its effect is found to be important for the stability and maximum growth of a given initial imperfection mode. Upper and lower bounds on the initial, uniform impulsive velocity loading are found (in terms of spherical shell geometry and material parameters) such that growth of initial displacement imperfections remains less than a prescribed multiplier when initial inward velocity lies outside the bounded region. 10 refs., 8 figs.

34126 (LBL-25715) **Aperture of two-counter telescopes.** Swanson, W.P. Lawrence Berkeley Lab., CA (USA). 3 Apr 1988. 12p. Sponsored by DOE Energy Research. DOE Contract AC03-76SF00098. Order Number DE89012851/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The telescope considered consists of two coaxial circular counters. The "aperture" $A_p \equiv \langle \Delta A \cdot \Delta\Omega \rangle$ is defined as the scalar quantity that satisfies the equation $C = A_p \times \phi_{isotropic}$ where C is the number of particles that pass through both counters ("counts"), and $\phi_{isotropic}$ is a broad uniform isotropic fluence as defined by the ICRU. If $\phi_{isotropic}$ is in units of cm^{-2} sr^{-1}, A_p will have units of cm^2 sr. Although the author was assured by experts that this problem had been solved many times over, a specific reference showing practical results could not be found. This note solves only the simple geometrical problem; particle "loss" by scattering or interactions in the telescope are not considered. 3 refs., 5 figs.

34127 (LBL-25722) **Sputtering of high-temperature superconductors: A bibliography.** Berdahl, P.; Buckius, R.B. Lawrence Berkeley Lab., CA (USA). Aug 1988. 28p. Sponsored by DOE Energy Research. DOE Contract AC03-76SF00098. Order Number DE89013374/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The literature on the sputtering of high-temperature superconducting cuprate thin films is presented. Much of the work is on $YBa_2Cu_3O_7$ and the related compounds with Y replaced by a +3 valence lanthanide. However, work on $(La_{1-x})_2CuO_4$ is included, as are the few available papers on films based on the Bi-Sr-Ca-Cu-O and Tl-Ca-Ba-Cu-O material systems. A listing of authors by institution shows which laboratories are currently most active in this field. 12 refs.

34128 (RFP-Trans-499) **Effect of oxidation, sandblasting and pickling on weldability.** Leinonen, J. Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant. Jun 1989. 23p. Translation of Report No. 28, 1981. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP03533. Order Number DE89013795/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Studies of the weldability problem of austenitic steels have led to new methods for improving weldability. Majetic and Yeo have patented a method on which the weldable surface is oxidized by annealing, or on it is spread a thin layer of certain oxides. The welding speed increases up to 350% due to the oxide layer. The weldability problems also disappear when a method invented by Moisio and Leinonen is used. In this case, small amounts of oxygen, carbon dioxide, or steam are added into the customary TIG shielding gases. A third way to improve the weldability is to sandblast the surface to be welded. If the weldability of steel is poor, it is often advisable to use the methods mentioned. The purpose of this study is to clarify the effects of oxidation, sandblasting, and pickling on penetration. The matter is particularly studied by welding tests performed under laboratory conditions. 13 refs., 5 figs., 2 tabs.

34129 (SAND-89-0393C) **Autonomous land navigation: A demonstration of retrotraverse.** Klarer, P.R. Sandia National Labs., Albuquerque, NM (USA). 1989. 8p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890783-1: 16. AUVS annual technical symposium and exhibit, Washington, D.C., USA, 17-19 Jul 1989). Order Number DE89011881/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This paper describes a hardware and software system developed to perform autonomous navigation of a land vehicle in a structured environment. The vehicle used for development and testing of the system was the Jeep Cherokee Mobile Robotics Testbed Vehicle developed at Sandia National Laboratories in Albuquerque. Since obstacle detection/avoidance has not yet been incorporated into the system, a structured environment is postulated that presumes the paths to be traversed are obstacle-free. The system performs path planning and execution (following) based on maps constructed using the vehicle's navigation system and onboard map-maker. The system configuration allows a map to be generated and stored during teleoperation of the vehicle, which may then be inverted and autonomously followed to perform "retrotraverse" back to the path start point. The system software, hardware, and performance data are discussed. 9 refs.

34130 (SAND-89-0484) **ASR4: A computer code for fitting and processing 4-gage anelastic strain recovery data.** Warpinski, N.R. Sandia National Labs., Albuquerque, NM (USA). May 1989. 49p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. Order Number DE89012239/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

A computer code for analyzing four-gage Anelastic Strain Recovery (ASR) data has been modified for use on a personal computer. This code fits the viscoelastic model of Warpinski and Teufel to measured ASR data, calculates the stress orientation directly, and computes stress magnitudes if sufficient input data are available. The code also calculates the stress orientation using strain-rosette equations, and its calculates stress magnitudes using Blanton's approach, assuming sufficient input data are available. The program is written in FORTRAN, compiled with Ryan-McFarland Version 2.4. Graphics use PLOT88 software by Plotworks, Inc., but the graphics software must be obtained by the user because of licensing restrictions. A version without graphics can also be run. This code is available through the National Energy Software Center (NESC), operated by Argonne National Laboratory. 5 refs., 3 figs.

34131 (SAND-89-0941C) **Development of a phenomenological constitutive model for polyurethane foams.** Neilsen, M.K.; Morgan, H.S.; Krieg, R.D.; Yoshimura, H.R. Sandia National Labs., Albuquerque, NM (USA). 1989. 8p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890631-40: International symposium on packaging and transporting of radioactive materials, Washington, D.C., USA, 11-16 Jun 1989). Order Number DE89013526/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Rigid, closed-cell, polyurethane foam is used in impact limiters in nuclear waste transport containers. During a hypothetical nuclear waste transport accident, the foam is expected to absorb a significant amount of impact energy by undergoing large inelastic volume reductions. Consequently, the crushing of polyurethane foams must be well characterized and accurately modeled to properly analyze a transport container accident. At the request of Sandia National Laboratories, a series of uniaxial, hydrostatic and triaxial compression tests on polyurethane foams were performed by the New Mexico Engineering Research Institute (NMERI). The combination of hydrostatic and triaxial tests was chosen to provide sufficient data to characterize both the volumetric and deviatoric behaviors of the foams and the coupling between the two responses. Typical results from the NMERI tests are included in this paper. A complete description of these tests can be found in Neilsen et al., 1987. Constitutive models that have been used in the past to model foam did not capture some important foam behaviors observed in the NMERI

tests. Therefore, a new constitutive model for rigid, closed-cell, polyurethane foams was developed and implemented in two finite element codes. Development of the new model is discussed in this paper. Also, results from analyses with the new model and other constitutive models are presented to demonstrate differences between the various models. 4 refs., 6 figs., 1 tab.

34132 (SAND–89-0983C) **Analyses of the transportation of spent research reactor fuel in the United States.** Cashwell, J.W.; Neuhauser, K.S. Sandia National Labs., Albuquerque, NM (USA). 1989. 9p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890631–44: International symposium on packaging and transporting of radioactive materials, Washington, D.C., USA, 11-16 Jun 1989). Order Number DE89013561/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We analyzed the impacts of transportation of research reactor spent fuel from US and foreign reactors for the US Department of Energy's (DOE) Office of Defense Programs. Two separate shipment programs were analyzed. The shipment of research reactor spent fuel from Taiwan to the US (Fuel Movement Program), and the return of research reactor spent fuels of US origin from foreign and domestic reactors (Research Reactor Fuel Return Program). To perform these analyses, a comprehensive methodology for analyzing the probabilities and consequences of transportation in coastal waters and port facilities, handling at the port, and shipment by truck to reprocessing facilities was developed. The Taiwanese fuel consists of low-burnup aluminum-clad metallic uranium research reactor spent fuel; the other fuels are primarily aluminum-clad oxide fuels. The Fuel Movement Program is ongoing, while the Fuel Return Program addresses future shipments over a ten-year period. The operational aspects of the Taiwanese shipments have been uniform, but several possible shipping configurations are possible for the Fuel Return Program shipments. The risks of transporting spent nuclear fuel and other radioactive materials by all modes have been analyzed extensively. Comprehensive assessments, which bound the impacts of spent fuel transport, demonstrate that when shipments are made in compliance with applicable regulations, the risks for all such transport are low. For comparison with previously licensed transport activities and to provide continuity with earlier analyses, the results for shipment of 150-day-old commercial pressurized water reactor (PWR) spent fuel are presented as part of this study.

34133 (SAND–89-0987C) **TRUPACT I filtered pressure equalization system.** Kincy, M.A.; Freedman, J.M. Sandia National Labs., Albuquerque, NM (USA). 1989. 9p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890631–31: International symposium on packaging and transporting of radioactive materials, Washington, D.C., USA, 11-16 Jun 1989). Order Number DE89013488/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A filtered pressure equalization system (FPES) for a waste transportation package has been designed and qualified to withstand the package environments induced by the normal and accident condition requirements specified in 10 CFR 71. The use of an FPES reduces the package structural requirements to withstand pressure variations due to gas generation from the payload and elevation changes, and permits the design of a more weight efficient package. The filter is capable of trapping airborne particles, should any be released from the contents to the containment vessel. Particle containment is important for flow from inside the package to outside. 1 ref., 5 figs.

34134 (SV-UB–1988-15) **Boltometer testing of reference bolt in the Final Repository for Reactor Waste (SFR), Forsmark.** Knape, P. Swedish State Power Board, Vaellingby (Sweden). 22 Jun 1988. 91p. (In Swedish). Order Number DE89618147/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

The Boltometer is an electronic instrument for non-destructive in situ testing and control of the quality of grouted rock bolts. For the purpose of controlling the permanence of rock bolting, a number of easily accessible reference bolts have been installed in SFR. 38 reference bolts and three production bolts, all located in the construction tunnel, are available for future control. The reference bolts are installed in different types of bedrock with changing tectonics and hydrology. Two boltometer tests have been made, the first one 33-40 hours after the grouting and the second one 34 days after. The results form both tests show some differences, indicating influence of the hardening process of the cement. The 34-day test will be the starting point for the evaluation of future testing. 14 of the reference bolts showed small, from the bolt end reflected waves, which were difficult to explain. The overcorings of three bolt show that the grouting of these bolts was of good quality. The reflected waves are induced by fractures in the bedrock at the inner end of the bolt. This investigation has also allowed a more precise classification than before of the previously installed bolts.

34135 (UCID–21675) **Fume hood exhaust duct fire tests: Building 222.** Staggs, K.J. Lawrence Livermore National Lab., CA (USA). May 1989. 14p. Sponsored by DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE89013385/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

In 1987 a new fiberglass-reinforced polyester (FRP) fume hood exhaust duct system was installed in Building 222 (Chemistry) at the Lawrence Livermore National Laboratory (LLNL). We conducted small-scale analysis and two large-scale fire tests to determine the burning characteristics of this type of ducting. The tests revealed that this material, used in this configuration, will easily burn and produce large amounts of smoke. Although this ducting had met certain fire and smoke standards, our tests determined that these standards do not provide a realistic test method for evaluating this ducting. Sprinklers were installed in each hood connected to the Bldg. 222 system; however, downward air-flow patterns in the hoods could prevent the sprinkler from operating before an in-hood fire reached the duct. Testing of other duct materials and components might reveal a more fire-resistive material that would not require sprinklers. 9 figs.

34136 (UCRL–99652) **Puncture evaluation of Shippingport package.** Lo, Ting-Yu. Lawrence Livermore National Lab., CA (USA). 26 May 1989. 12p. Sponsored by DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-890631–51: International symposium on packaging and transporting of radioactive materials, Washington, D.C., USA, 11-16 Jun 1989). Order Number DE89013777/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A puncture evaluation of a 900-ton type B category II shipping package was performed. The package consisted of the decommissioned Shippingport reactor pressure vessel (RPV) with its neutron shield tank (NST) in a concentric arrangement. The space inside the RPV and in annulus between the RPV and the 1-inch-thick NST was filled with concrete. The package was assumed to drop 40 inches into a 6-inch-diameter puncture bar of sufficient length to reach the RPV. The objective was to evaluate the puncture potential of the RPV. A nonlinear dynamic finite element analysis was performed. The NST and the concrete in the annulus were assumed to provide little resistance to puncture because the NST shell is thin and the concrete strength is low. In addition to the dynamic finite element evaluation of the package, a simple buckling analysis of the puncture bar was also performed. The buckling analysis was based on the tangent modulus theory of inelastic buckling. It was found that the puncture bar will not penetrate the RPV under the most severe stress state during the impact process. It was also found that the puncture bar will buckle long before this most severe stress state in the RPV can be reached. The package possesses so much kinetic energy before impact, a small fraction of this energy is sufficient to either buckle or overstress the puncture bar before the stresses in the RPV become critical. 5 refs., 3 figs., 1 tab.

34137 (UCRL–100548) **CAMAC control of diverse data acquisition instrumentation.** Montelongo, S. Lawrence Livermore National Lab., CA (USA). 28 Apr 1989. 7p. Sponsored by DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-890545–2: 6. conference on real-time computer applications in nuclear, particle and plasma physics, Williamsburg, Virginia, USA, 15-18 May 1989). Order Number DE89013149/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The LLNL Nuclear Chemistry Counting Facility has been converted into a modern research facility. A distributed data-acquisition network has been designed and implemented for this conversion. A major task of the conversion was to provide support for diverse nuclear instrumentation using the CAMAC instrumentation standard. This paper addresses the design and implementation of a CAMAC

subsystem incorporated into the data-acquisition network. 4 refs., 8 figs.

34138 (WSRC-RP-89-61) **Building 774A mini-melter restoration.** Mensink, D.L. Savannah River Lab., Aiken, SC (USA). 14 Apr 1989. 16p. Sponsored by DOE Defense Programs. DOE Contract AC09-89SR18035. Order Number DE89013474/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Large scale mechanical improvements were made on the 100th scale glass melter in building 774A following a shutdown in November, 1988. The circumstances regarding that shutdown were reported by P.M. Allen in DPST-89-345. By request, the Mechanical Development Group assumed responsibility for the work on SRL Service order DS-87042. This report describes the changes which were made, their purpose, and observations as to their effectiveness after approximately 4 weeks of operating with the improvements in-place. Recommendations for further improving the equipment are also noted. The old melter design, now superseded, is documented in drawings ST5-23838 through ST5-23847. As-built drawing arrangements and details for the new work is shown in drawings SK5-6191-LD through SK5-6197-LD. Other design details are referenced in the drawings which were developed for the new shielded cells Research Melter, ST5-25111 through ST5-25124.

34139 (Y-2405) **Hierarchical architecture for automated electrom beam (EB) welding systems: Exception handling and robust controllers.** Greer, J.T. Oak Ridge Y-12 Plant, TN (USA). May 1989. 54p. Sponsored by DOE Defense Programs. DOE Contract AC05-84OS21400. Order Number DE89012876/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

The wide interest in electron beam (EB) manufacturing applications has intensified because of interest in high-productivity and high-quality manufacturing. Applications for EB welding in space, defense projects, Strategic Defense Initiative space stations, and the construction of NASA's space modulus have also intensified the interest for automated EB welding systems. A control system that will provide "robust" automation and exception handling requires extensive knowledge of the process. For complex, multivariable, nonlinear, nonstationary processes, various techniques are usually required to capture the knowledge necessary to handle process exceptions. This report develops a methodology and hierarchical control structure and applies to the the EB welding control problem. The EB gun controller is specifically used to illustrate the methodology and the mapping into the proposed hierarchical control and analysis structure. Special attention is given to the process evaluator element of the hierarchical analysis structure, which utilizes a combination of qualitative, procedural, and mathematical models to evaluate and to handle process exceptions. The EB gun, filament controller, and emission controller are modeled and integrated so that the system/subsystem issues can be evaluated. 15 refs., 25 figs.

34140 Vitreous ice as a cryoprotectant for imaging atom-probe studies of adsorption phenomena at a solid–liquid interface. Panitz, J. A. (Department of Physics and Astronomy and Department of Anatomy, School of Medicine, University of New Mexico, Albuquerque, New Mexico 87131(US)). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films (USA)*, 7(4): 2850-2853 (Jul 1989).

A novel approach is outlined for studying adsoption phenomena at a solid–liquid interface in the imaging atom-probe mass spectrometer. An interface is preserved for analysis by embedding it within a thin, conducting layer of vitreous ice formed from its native environment. The ice is controllably sublimed at 20 K using a high electric field to dissect the layer, and to map the distribution of species within the layer as a function of depth from its surface. Procedures are described for creating a layer of ice believed to be vitreous in nature, and for transporting an interface embedded within the ice layer into high vacuum without damage (and without contamination from laboratory ambient). Field-ion imaging suggests these procedures are effective for preserving the surface structure of a solid on a subnanometer scale.

4203 Lasers

Refer also to citation(s) 33406, 33961, 33962, 33964, 33994, 34003, 35510

34141 (AD-A-201170/8/XAB) **Free-electron laser driven by the NBS (National Bureau of Standards) c-w microtron. Annual report, 1 April 1987-31 March 1988.** National Bureau of Standards, Washington, DC (USA). 31 Mar 1988. 149p. Available from NTIS, PC A07/MF A01.

The overall goal of this project is to construct and bring into operation a free-electron laser (FEL) driven by the racetrack microtron (RTM) electron accelerator at NBS. NBS is providing the RTM, radiation-shielded laboratory space for the RTM and FEL, and experimental areas. The scope of the project includes: modifying the RTM injector for increased peak current; developing electron beam transport from the RTM to the FEL: developing a wiggler and optical cavity; and developing optical beam transport and diagnostics.

34142 (AD-A-201593/1/XAB) **Bibliography of Soviet laser developments, Number 90, July-August 1987.** Defense Intelligence Agency, Washington, DC (USA). Directorate for Scientific and Technical Intelligence. 27 Jun 1988. 163p. (DIA-DST-2700Z-004-88). Available from NTIS, PC A08/MF A01.

USSR/laser materials; USSR/lasers; LASER MATERIALS; LASERS/bibliographies; USSR; LASERS; OPTICS; HOLOGRAPHY; PULSES; SOLID STATE LASERS; LIQUID LASERS; GAS LASERS; CHEMICAL LASERS; BIBLIOGRAPHIES; NONLINEAR OPTICS

34143 (AD-A-201612/9/XAB) **Kinetic processes in discharge-pumped mercury halide lasers. Final report, May 1985-July 1988.** Kushawaha, V.S. Howard Univ., Washington, DC (USA). 15 Aug 1988. 3p. Available from NTIS, PC A02/MF A01.

This report describes the formation of excited-state species observed during collisions involving $HgX_2/CH_3HgX(X=C,BR,I)$ molecules and electrons or ions at different laboratory kinetic energies. Electron impact dissociation of HgX_2 and CH_3HgX was studied and formation of HgX (2sigma) radicals and highly excited state of Hg atoms was observed in the laboratory kinetic energy range of 1-100eV. With electron and CH_3HgX collisions, emissions from CH radicals and atomic hydrogen were also observed, in addition to the above mentioned species.

34144 (AD-A-201635/0/XAB) **Chaotic electron motion caused by sidebands in free electron lasers. Interim report.** Riyopoulos, S.; Tang, C.M. Naval Research Lab., Washington, DC (USA). 27 Oct 1988. 86p. (NRL-MR-6365). Available from NTIS, PC A05/MF A01.

The electron dynamics in a free-electron laser (FEL) is studied in the case when the radiation field contains many modes. This situation arises when unstable modes (sidebands) are excited during operation. It is observed that when the strength of these sidebands exceeds certain levels, the electron motion becomes chaotic. This may lead to extensive particle detrapping and loss of amplification for the FEL signal. The threshold for the onset of stochastic electron motion is computed. The evolution of the trapped-electron distribution exhibits a diffusive behavior. The rate of particle detrapping is parameterized by the diffusion coefficient D in action space. It is found that the diffusion rates are connected to the type of the sideband spectrum. The diffusion coefficient is always proportional to the ratio of the sideband power in all frequencies to the power of the carrier signal. The coefficient of the proportionality, however, scales differences to the FEL parameters for each of the three spectral categories: a narrow, a broad discrete and a broad continuous spectrum. The diffusion coefficient is computed analytically for the last two cases and is in good agreement with numerical results. The narrow spectrum yields the highest and the broad continuous the measured in wiggler periods, is independent of the electron energy.

34145 (AD-A-201641/8/XAB) **Spectrally resolved near-field intensity measurements from gain-guided twin-stripe laser diode arrays. Technical report.** Heflinger, D.G.; Fenner, W.R. Aerospace Corp., El Segundo, CA (USA). Electronics Research Lab. 1 Nov 1988. 19p. (TR-0086A(2925-04)-1). Available from NTIS, PC A03/MF A01.

Gain-guided twin-stripe laser diodes were observed that exhibit two distinct sets of longitudinal modes, one corresponding to a single near-field intensity profile centered between the stripes and the other to a double-lobe near-field distribution centered under the stripes. A large spectral separation between these two sets of modes was also measured. The double-lobe distribution probably results from a weak index guide, which occurs because of the decrease in the current density between stripes. The spectral separation between these two near-field modes is believed to be due to band filling.

34146 (DOE/DP/40130–2) **KrF short pulse extractor studies: Quarterly progress report, 1 November 1980–1 February 1981.** Mandl, A. Avco-Everett Research Lab., Everett, MA (USA). 1981. 14p. Sponsored by DOE Defense Programs. DOE Contract AC08-80DP40130. Order Number DE89013018/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A waterline has been installed and integrated into the KrF short pulse device. Initial tests on the system have demonstrated a 200 nsec e-beam pulse with a 35 nsec risetime delivering a current density of 48 A/cm^2 at 250 kW inside a 1 m laser cavity. 5 figs.

34147 (DOE/ER/52147–2) **Free electron lasers with small period wigglers: Progress report, September 15, 1988–September 14, 1989.** Antonsen, T.M. Jr.; Booske, J.H.; Destler, W.W.; Granatstein, V.L.; Mayergoyz, I.D.; Ott, E. Maryland Univ., College Park, MD (USA). May 1989. 57p. Sponsored by DOE Energy Research. DOE Contract FG05-87ER52147. Order Number DE89014715/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

Progress of research on a short period wiggler (SPW) free electron laser (FEL) with a sheet electron beam is reviewed. Most of the recent work has concentrated on addressing thermal engineering issued in the device. This particular emphasis was particularly stimulated by an evaluation by Panel XXI for the Magnetic Fusion Advisory Committee which stated: "There are serious thermal management engineering uncertainties in the electron gun, the microwave cavity, and the wiggler that will need to be addressed for CW operation. In the panel's judgment, these thermal problems are likely to be insurmountable for fusion applications... ." In fact, recent experimental and theoretical results challenge this judgment. For example, our most recent conceptual designs involve small-to-negligible rf losses in the cavity walls. In addition, we have convincingly established that for electron beams of quality achievable with thermionic Pierce guns, body currents should be negligible to nonexistent, thus ensuring a thermally stable cavity. These discoveries, as well as other research progress, are reviewed in detail in the following report. Plans are described for a pulsed (100 ns) proof-of-principle "lasing" experiment to be conducted during the remainder of this fiscal year. In addition, we present a revised statement of work and budget for the follow-on year of the current grant. These proposed tasks will address the remaining risk issues for an ERCH source based on the SPW sheet-beam FEL. Upon the completion of those tasks, sufficient information will exist to confidently assess the feasibility of the proposed concept. 43 refs., 21 figs., 2 tabs.

34148 (LBL–26783-Vol.1) **Report of the workshop on scientific opportunities for infrared free-electron lasers: Volume 1.** Lawrence Berkeley Lab., CA (USA); Brookhaven National Lab., Upton, NY (USA). Feb 1989. 38p. Sponsored by DOE Energy Research. DOE Contract AC03-76SF00098;AC02-76CH00016. (CONF-8810126–Vol.1-Summ.: Workshop on scientific opportunities for infrared free electron lasers, Berkeley, California, USA, 31 Oct - 1 nov 1988). Order Number DE89012836/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

With the characteristics of very broad wavelength coverage, high average and peak power, and variable time structure, the free-electron laser (FEL) shows great promise of having a major impact in many areas of science and technology – an impact similar to those of the ultrahigh vacuum system, the computer, and the conventional laser. As a technology, the FEL has reached an advanced development stage. There are several FELs in operation and several more in the design stage. However, as a tool for scientific research and applications it is still very much in its infancy. Now is an appropriate time to define the FELs that are needed to perform the science that should and can be done, particularly with the characteristics that are unique to FELs. A workshop co-sponsored by Lawrence Berkeley Laboratory and Brookhaven National Laboratory was held on October 31–November 1, 1988 with this goal in mind. The workshop focused on the infrared region where there is a scarcity of intense sources and where the FEL technology is most mature. The purposes of the workshop were: to review the performance of existing infrared FELs; to identify the significant scientific experiments that could be done, as well as those that are being done, with these FELs; and to define the FEL characteristics that are required to realize these possibilities and how they can be achieved.

34149 (PB–89-855282/XAB) **Q-switched lasers. June 1972-February 1989 (Citations from the International Aerospace Abstracts data base). Report for June 1972-January 1989.** National Technical Information Service, Springfield, VA (USA). Feb 1989. 62p. Available from NTISPC N01/MF N01.

U.S. sales only.

This bibliography contains citations concerning the design, development, and results of operations of Q-switched lasers. Included are materials, oscillators, resonators, and modulators for Q-switching. (Contains 127 citations fully indexed and including a title list.)

34150 Far-infrared science and technology. SPIE - Volume 666. Izatt, J.R. 219p. SPIE Society of Photo-Optical Instrumentation Engineers, Bellingham, WA (1986). (CONF-8606370–: Far-infrared science and technology meeting, Quebec, Canada, 5-6 Jun 1986).

This book collects papers given at a conference on far-infrared technology. Topics include: far-infrared lasers, carbon dioxide lasers, free-electron lasers, optical pumping, frequency control, exotic superconductors, and interferometers in Tokamaks.

34151 High speed photography, videography, and photonics V. SPIE - Volume 832. Johnson, H.C. 393p. SPIE Society of Photo-Optical Instrumentation Engineers, Bellingham, WA (1987). (CONF-8708231–: High speed photography, videography, and photonics V, San Diego, California, USA, 17-19 Aug 1987).

These proceedings collect papers on photograph and photonics. Topics include: wavefront measurement, laser velocimeters, mirror framing laser shadowgraph cameras, streak cameras, cineradiography, pulsed laser stereophotography of plasmas, dynamic range optimization, x-ray streak cameras for fusion diagnostics, and time-resolved x-ray photography.

34152 Ultrastable carbon dioxide (CO_2) lasers. Freed, C. (Massachusetts Institute of Technology, Lincoln Lab., P.O. Box 73, Lexington, MA (US)). v.v of Gas laser technology. Sauerbrey, R.A.; Tillotson, J.H.; Chenausky, P.P. SPIE Society of Photo-Optical Instrumentation Engineers, Bellingham, WA (1988). (CONF-8801118–: Gas laser technology, Los Angeles, California, USA, 11-12 Jan 1988).

This paper reviews the spectral purity, frequency stability and long-term stabilization of CO_2 isotope lasers developed at MIT Lincoln Laboratory. Extremely high spectral purity and short-term stability of less than 1.5×10^{-13} have been achieved and will be discussed. A long-term stabilization technique, which was used to line-center lock any regular or hot-band CO_2 isotope laser transition, is described. A brief description on using CO_2 lasers as secondary frequency standards is also given.

34153 Polarization effects in laser-pumped Nd:YAG lasers. Esherick, P. (Sandia National Labs., Albuquerque, NM (US)); Owyoung, A. v.v of Pulsed single-frequency lasers. Bischel, W.K.; Rahn, L.A. SPIE Society of Photo-Optical Instrumentation Engineers, Bellingham, WA (1988). (CONF-880199–: Pulsed single frequency lasers: technology and applications, Los Angeles, California, USA, 12-13 Jan 1988).

The authors' investigations into the polarization properties of mechanically-stressed monolithic Nd:YAG oscillators have led to two important discoveries. First is the applicability of mechanical stress as a means for rapidly tuning the output frequency of a single-mode monolithic oscillator. The second, quite unexpected, discovery is that the polarization emitted by such a Nd:YAG oscillator is strongly dependent on both the polarization and precise wavelength of the (nominally 800 nm wavelength) pump radiation.

34154 Quenched-laser operation of a Littman dye oscillator. Raymond, T.D. (Sandia National Labs., Albuquerque, NM (US)); Reiser, C.; Esherick, P.; Michie, R.B. v.v of Pulsed single-frequency lasers. Bischel, W.K.; Rahn, L.A. SPIE Society of Photo-Optical Instrumentation Engineers, Bellingham, WA (1988). (CONF-880199–: Pulsed single frequency lasers: technology and applications, Los Angeles, California, USA, 12-13 Jan 1988).

The authors demonstrate a means of generating narrowband, tunable laser pulses near 650 nm with continuously adjustable pulse width from 0.2 to 3 nsec. The system utilizes a short-cavity single-mode Littman oscillator which is quenched by a second short-cavity dye laser. Both are pumped by the same 6-nsec full width-at-half-maximum (FWHM) frequency-doubled single-mode Nd:YAG laser. They also demonstrate a polarization technique in the three-stage amplification of these pulses to an energy of 20 mJ with minimum temporal broadening.

34155 Multifaceted laser beam integrators. Dickey, F.M. (Sandia Nat. Lab., Albuquerque, NM (US)); O'Neil, B.D. v.v of Current developments in optical engineering II. Fischer, R.E.; Smith, W.J. SPIE Society of Photo-Optical Instrumentation Engineers, Bellingham, WA (1987). (CONF-8708232–: Current developments in optical engineering II, San Diego, California, USA, 18-21 Aug 1987).

This paper discusses multifaceted mirror configurations for transforming an arbitrary laser beam irradiance pattern onto a uniform irradiance pattern. Three configurations are presented and compared, one of which allows for the elimination of diffraction effects. Aberration effects associated with the relaying or imaging of the irradiance pattern and a novel technique for correction are also discussed.

34156 Measurement of two-photon absorption cross sections in atomic O at 226 nm. Bamford, D.J. (SRI International Chemical Physics Lab., Menlo Park, CA (US)); Bischel, W.K.; Hickman, A.P.; Dyer, M.J. v.v of Pulsed single-frequency lasers. Bischel, W.K.; Rahn, L.A. SPIE Society of Photo-Optical Instrumentation Engineers, Bellingham, WA (1988). (CONF-880199–: Pulsed single frequency lasers: technology and applications, Los Angeles, California, USA, 12-13 Jan 1988).

Absolute atomic bound-bound two-photon cross sections have been measured using a single-frequency laser, eliminating the usual uncertainties about unresolved temporal fluctuations. The cross sections were measured using the technique of two-photon excited fluorescence. For the $3p^3P_{2,1,0\leftarrow 2p}$sup 3/P2/transition in atomic oxygen at 226 nm the integrated cross section (obtained by scanning the laser frequency through the two-photon resonance) is $1.87\pm0.60 \times 10^{-35}$ cm^4. Relative fine structure cross sections and energy spacings have been measured by Doppler-free spectroscopy. Absolute and relative two-photon cross sections agree well with ab initio calculations. Comparison with similar measurements carried out with multimode lasers yields information about multimode laser photon statistics. The experimental integrated cross section is shown to be proportional to the product of the atomic cross section and $G(^2)$ (O), the second-order intensity correlation at time zero of the laser field. It is assumed that $G(^2)$ (O)=1.0 for the single-frequency laser source. Five other laser 226 configurations have values of $G(^2)$ (O) ranging from 0.8 ± 0.2 to 3.2 ± 0.4. Until multimode lasers are well enough understood to allow predictions of $G(^2)$ (O) (especially after frequency conversion processes such as doubling and Raman shifting), single-frequency lasers will be the best source of reliable multiphoton cross section measurements.

34157 High resolution inverse Raman spectroscopy of the CO Q branch. Rosasco, G.J. (Center for Basic Standards, U.S. National Bureau of Standards, Gaithersburg, MD (US)); Looney, J.P.; Hahn, J.W.; Rahn, L.A.; Palmer, R.E. v.v of Pulsed single-frequency lasers. Bischel, W.K.; Rahn, L.A. SPIE Society of Photo-Optical Instrumentation Engineers, Bellingham, WA (1988). (CONF-880199–: Pulsed single frequency lasers: technology and applications, Los Angeles, California, USA, 12-13 Jan 1988).

Preliminary results of a high resolution spectroscopic study of the pressure dependence of the Raman vibrational Q-branch spectrum of pure CO are reported. Measurements are made at room temperature over the pressure range 0.5 to 6 atm. The technique of quasi-cw inverse Raman spectroscopy utilizing a pulsed single-frequency laser source is employed. This approach gives enhanced sensitivity compared to earlier work which employed cw lasers, allowing extension of that work to higher accuracy, higher J states, and higher pressure. The goal of this work is to test the accuracy of a modified exponential-gap rate law model which is used to predict the pressure dependent spectra.

34158 Analytical applications of nonlinear optics including phase conjugation. Ramsey, J.M. (Oak Ridge National Lab., Oak Ridge, TN (US)). v.v of Proceedings of the 24th Eastern Analytical Symposium, Inc. Litarvin Literature, Arvada, CO (1987). (CONF-861009–: Silver Jubilee Eastern Analytical symposium, New York, New York, USA, 20-24 Oct 1986).

Optical phase conjugation (OPC) is a relatively new field of study. It is a nonlinear optical technique that retroreflects a coherent optical beam and also compensates for phase distortion. These properties are of great interest to those working in the optics community and have also proven useful to the spectroscopist. The authors have been exploring the possibilities of using OPC techniques for two different aspects of spectroscopy. The first study involves the use of OPC to control the bandwidth and frequency of a CW dye laser. The dye laser is operated with no intracavity tuning elements. The laser is tuned by an extracavity barium titanate crystal which acts as a passive phase conjugate reflector. A dye laser has been narrowed to 1.3 GHz and passively scanned over 25 nm using this approach. The authors have found this laser to be useful for high resolution spectroscopy. In other investigations the strength of the retroreflection is used to monitor the nonlinear medium. This OPC signal greatly increases near optical transitions due to resonance enhanced nonlinearities. Thus, sample dependent spectra can be generated by monitoring the retroreflection. The authors have been examining the analytical utility of such spectroscopic measurements, specifically for elemental analysis. OPC is achieved in both of these experiments by degenerate four wave mixing (DFWM). The fundamentals of OPC and DFWM are presented in addition to the details of the experiments in their laboratories.

34159 New applications and designs for deformable mirrors. Bliss, E.S. (Lawrence Livermore National Lab., Univ. of California, Livermore, CA (US)); Smith, J.R.; Miller, R.L. v.v of Nonlinear optical beam manipulation, beam combining, and atmospheric propagation. Fischer, R.A. SPIE Society of Photo-Optical Instrumentation Engineers, Bellingham, WA (1988). (CONF-8801121–: Nonlinear optical beam manipulation, beam combining, and atmospheric propagation, Los Angeles, California, USA, 11-14 Jan 1988).

A rectangular deformable mirror is described which meets the low spatial frequency and low bandwidth requirements associated with thermal aberrations in a solid state zig-zag amplifier. The authors incorporate design features which simplify the design of the mirror itself and reduce the complexity of the associated control system.

34160 Measurement of atomic oscillator strengths using pulsed single-frequency dye lasers. Haynam, C. (Lawrence Livermore National Lab., Laser Isotope Separation Program, P.O. Box 5508, Livermore, CA (US)); Comaskey, B.; Johnson, M.; Paisner, J.; Worden, E. v.v of Pulsed single-frequency lasers. Bischel, W.K.; Rahn, L.A. SPIE Society of Photo-Optical Instrumentation Engineers, Bellingham, WA (1988). (CONF-880199–: Pulsed single frequency lasers: technology and applications, Los Angeles, California, USA, 12-13 Jan 1988).

The authors have used two methods to measure the oscillator strength of the transition between the ground and 17992 cm^{-1} level in ^{174}Yb. The first technique involves exciting the transition with a laser pulse that is nearly time-bandwidth limited, of uniform intensity, and has reproducible shape from shot to shot. The population left in the excited state after pulse varies sinusoidally with a period that depends on the integral over time of the electric field amplitude and the transition oscillator strength. These are the Rabi oscillations that are predicted by application of the Schrodinger equation to the two-level atom. The excited-state population is probed using a two-step photoionization to the continuum. The electric field amplitude is determined from the temporal profile and the intensity of the laser pulse. The second method involves observation of the polarization rotation of a set of degenerate sublevels brought about by a time-bandwidth limited light-shift laser. One sublevel (m_j=0) of the J=1 level at 17992 cm^{-1} is populated by a linearly polarized laser. A

second copropagating light-shift laser, which is linearly polarized at an angle to the first laser, is tuned between 7.5 and 30 GHz off-resonance with the transition. The light-shift laser causes population to be promoted into the $m_j=\pm1$ levels by a virtual transition through the ground J=0, $m_j=0$ level. Two linearly polarized photoionizing lasers photoionize the population only from the $m_j=\pm1$ levels. The photoion signal oscillates sinusoidally with a period that depends only on the integrated pulse intensity, the laser detuning, and the transition oscillator strength.

34161 Modern pulsed wavemeters. Reiser, C. (Div. 1124, Sandia National Labs., Albuquerque, NM (US)). v.v of Pulsed single-frequency lasers. Bischel, W.K.; Rahn, L.A. SPIE Society of Photo-Optical Instrumentation Engineers, Bellingham, WA (1988). (CONF-880199–: Pulsed single frequency lasers: technology and applications, Los Angeles, California, USA, 12-13 Jan 1988).

Several technologies are available for interferometrically measuring laser wavelength to the precision of a Doppler width. These include instruments based on Fabry-Perot etalons, Fizeau wedges, Michelson interferometers, and other novel schemes. The current state of the art of these instruments is reviewed. Two new pulsed wavemeter designs are presented, the solid Fizeau wedge an the index mismatched interferometer. These instruments exhibit accuracies in the 10^6 range, and are very compact and inexpensive to fabricate.

34162 Permanent-magnet Faraday isolators for Q-switched Nd. Schmitt, R.L. (Sandia National Labs., Livermore, CA (US)); Rahn, L.A. v.v of Pulsed single-frequency lasers. Bischel, W.K.; Rahn, L.A. SPIE Society of Photo-Optical Instrumentation Engineers, Bellingham, WA (1988). (CONF-880199–: Pulsed single frequency lasers: technology and applications, Los Angeles, California, USA, 12-13 Jan 1988).

The authors discuss the design of high-performance, single-pass, permanent-magnet Faraday isolators that are simple to construct and use. An isolator, designed for use with Q-switched Nd:YAG laser systems, that is 10 cm long and achieves 41 degrees of rotation at 1.06 μm is described.

34163 Rotating shearing plate interferometer. Sweatt, W.C. (Sandia Nat. Labs., Albuquerque, NM (US)); Duffus, R.C. v.v of Current developments in optical engineering II. Fischer, R.E.; Smith, W.J. SPIE Society of Photo-Optical Instrumentation Engineers, Bellingham, WA (1987). (CONF-8708232–: Current developments in optical engineering II, San Diego, California, USA, 18-21 Aug 1987).

The rotatable shearing plate interferometer provides a fast and simple manual method of measuring defocus, astigmatism and coma in a collimated laser beam. The shearing plate is mounted at a 45 degree angle relative to the incident beam. The plate in its housing is rotated about the axis of the incident beam. This allows the beam to be sheared in the horizontal, the vertical, or any other direction. Astigmatism and defocus can be calculated from fringe tilt measurements taken at any three angles, for example, 0, 45 and 90 degrees. Coma can be calculated from fringe curvatures measured at 0 and 90 degrees.

34164 Synchronously pumped subpicosecond dye oscillator-amplifier system. Roberts, J.P. (Los Alamos National Lab., Los Alamos, NM (US)); Taylor, A.J.; Lester, C.S.; Gosnell, T.R. v.v of Proceedings of the conference on lasers and electro-optics. Optical Society of America, Washington, DC (1988). (CONF-880402–: CLEO '88: OSA/IEEE conference on lasers and electro-optics, Anaheim, California, USA, 25-29 Apr 1988).

Operation of tunable subpicosecond dye lasers, pumped by cw mode-locked Nd:YAG lasers, has been demonstrated over a broad wavelength range. Amplification of laser pulses to the 1-mJ level is, however, often required for purposes such as subpicosecond ultraviolet pulse generation via nonlinear mixing. The standard system for this purpose utilizes a four-stage dye amplifier pumped by a frequency-double Q-switched Nd:YAG laser. A disadvantage of this approach, however, is that poor beam quality results from nonuniformity in the pump beam and the transverse pumping geometry used in the first three stages. A more elegant design replaces the separate pump laser for the dye amplifier with a regenerative Nd:YAG amplifier seeded by the 1.06-μm 100-ps pulses from the cw mode-locked Nd:YAG laser. Synchronous amplification of 0.17-ps pulses up to energies of 1.5 μJ has been previously demonstrated using the 1-mJ output from such a regenerative amplifier. The authors report on a tunable dye oscillator-amplifier system capable of producing 1-mJ subpicosecond pulses. The oscillator consists of a linear-cavity dispersion-compensated dye laser with separate gain and absorber jets that is synchronously pumped by a cw mode-locked Nd:YAG laser. The dye-amplifier that follows is pumped with the 30-mJ output of a Nd:YAG regenerative amplifier.

34165 Impurity induced disordered quantum well heterostructure stripe geometry lasers by MeV oxygen implantation. Bryan, R. P. (Materials Research Laboratory, University of Illinois, 1406 West Green Street, Urbana, Illinois 61801(US)); Coleman, J. J.; Miller, L. M.; Givens, M. E.; Averback, R. S.; Klatt, J. L. *Applied Physics Letters (USA),* 55(2): 94-96 (10 Jul 1989). DOE Contract AC02-76ER01198.

Data are presented on stripe geometry AlGaAs-GaAs graded barrier quantum well heterostructure lasers formed by MeV oxygen implantation and annealing. Low-dose implants are found to suppress lateral carrier diffusion but do not result in compositional disordering. High-dose implants form both a semi-insulating and a compositionally disordered region leading to index-guided buried-heterostructure laser operation. However, the concentration of oxygen which spreads laterally under the implantation mask during high-dose implants is sufficient to partially compensate the stripe region for narrow stripe widths and thereby significantly increases the threshold current.

34166 Efficiency enhancement in cyclotron autoresonance maser amplifiers by magnetic field tapering. Chen, C. (Department of Physics and Plasma Fusion Center, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139(US)); Wurtele, J. S. *Physical Review [Section] A: General Physics (USA),* 40(1): 489-492 (1 Jul 1989).

The efficiency of cyclotron autoresonance maser (CARM) amplifiers withpiecewise linear tapering of the magnetic field is analyzed. In the low-currentlimit, we find that increasing the magnetic field substantially enhances theefficiency if an effective detuning parameter is positive, while decreasing themagnetic field is advantageous when the detuning parameter is negative. Forhigh-current, high-gain, CARM operation the efficacy of tapering is found to bereduced in a parameter regime where the saturation wave amplitude becomes ofthe order of an effective detuning parameter.

34167 Thermal blooming compensation instabilities. Karr, T. J. (Lawrence Livermore National Laboratory, Livermore, California 94550(US)). *Journal of the Optical Society of America A: Optics and Image Science (USA),* 6(7): 1038-1048 (Jul 1989). DOE Contract W-7405-ENG-48.

A general model is developed for the time-dependent growth of small perturbations in thermally bloomed beams with and without correction. Intensity and phase everywhere along the path of an intense forward beam and a weak backward beam are determined from the initial beam and path conditions by five time-dependent Green functions. The Green functions are exact solutions of the combined linearized blooming and turbulence problems and are given in closed form for an arbitrary path. Any correction method is a boundary condition connecting the forward and backward fields. Time-dependent instabilities correspond to singularities in the appropriate combination of Green functions. Perfect field conjugation gives perfect correction and is stable at all spatial frequencies. Perfect phase-reversal correction is unstable at all spatial frequencies. The instability growth rate is proportional to absorbed irradiance, and the total gain in a convection clearing time is proportional to the dimensionless blooming number. High gain is predicted in moderate blooming. Convection shear reduces the gain for irradiances with an instability growth rate much smaller than the shear rate and suppresses the gain for irradiances with a Rayleigh-range optical-path-difference growth rate much smaller than the shear rate.

4204 Heat Transfer and Fluid Flow

Refer also to citation(s) 33137, 33492, 34106, 34121

34168 (AD-A-201470/2/XAB) **Coupled, parabolic-marching method for the prediction of three-dimensional viscous incompressible turbomachinery flows. Doctoral thesis.** Kirtley, K.R. Pennsylvania State Univ., University Park, PA (USA). Applied Research Lab. Oct 1988. 219p. (ARL/PSU/TR-88-014). Available from NTIS, PC A10/MF A01.

A new coupled parabolic-marching method was developed to solve the three-dimensional incompressible Navier-Stokes equation for turbulent turbomachinery flows. Earlier space-marching methods were analyzed to determine their global stability during multiple passes of the computational domain. The methods were found to be unconditionally unstable even when an extra equation for the pressure, namely the Poisson equation for the pressure, was used between passes of the domain. Relaxation of one constraint during the solution process was found to be necessary for the successful calculation of a complex flow.Thus, the method of pseudocompressibility was introduced into the partially parabolized Navier-Stokes equation to relax the mass flow constraint during a forward-marching integration as well as globally stable during successive passes of the domain. With consistent discretization, the new method was found to be convergent.

34169 (CEA-CONF-9708) **Two-phase cross flow damping in tube arrays.** Axisa, F.; Wullschleger, M.; Villard, B.; Taylor, C. CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Etudes Mecaniques et Thermiques. 1988. 23p. (CONF-8806217--: ASME pressure vessel and piping conference: vibration and seismic response of fluid-structure systems, Pittsburgh, Pennsylvania, USA, 19-23 Jun 1988). Order Number DE89760602/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

To avoid excessive flow-induced vibration at the U bend spans of steam generators it is necessary to have information on two-phase flow damping. This paper reviews the data we obtained in different tube arrays subjected either to air/water or to steam/water flows, at high void fraction. At first, experimental difficulties in obtaining reliable damping measurements in flexible tube arrays are emphasized. However, the present data are still certainly tainted with experimental errors. It appears clearly that void fraction and nature of the two-phase mixture are important parameters for controlling two-phase flow damping in tube arrays. Namely dissipation is found to be significantly less in steam/water than in air/water, at least in the high void fraction range.

34170 (EPRI-ER-6364) **Horizontal-flow boiling heat transfer using refrigerant mixtures: Final report.** Jung, D.S.; Didion, D.A. Electric Power Research Inst., Palo Alto, CA (USA); National Inst. of Standards and Technology (NEL), Gaithersburg, MD (USA). Center for Building Technology. c May 1989. 221p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Mixture effects were studied on horizontal convective heat transfer for both nonazeotropic, R22/R114, and azeotropic, R12/R152a, mixtures. A test facility was designed, constructed, and operated to simulate evaporators in heat pump and refrigeration systems. More than 3000 local two-phase heat transfer coefficients were obtained under steady state condition for annular flow at a reduced pressure of 0.08. The results indicated that there were two distant heat transfer regions; partial boiling and convective evaporation. In the partial boiling region, heat transfer coefficients were strongly dependent upon heat flux; the heat flux dependence disappeared for high vapor qualities. A full suppression of nucleate boiling was observed for both pure and mixed refrigerants. For a given heat and mass flux, nucleate boiling was suppressed at lower qualities for mixtures than for pure fluids. The unique phenomenon of loss of available superheat for mixtures caused nucleate boiling to be suppressed at lower qualities. An analytical study was performed to predict the transition quality by utilizing a theory of onset of nuclear boiling and phase equilibrium data. The prediction agreed very well with the present data. 77 refs., 62 figs., 14 tabs.

34171 (GKSS-88/E/58) **Flow pattern and pressure drop in tees.** Katsaounis, A. GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Anlagentechnik. 17 Jan 1987. 21p. Available from Special print from Chem. Eng. Commun. (1987) v. 54 p. 119-138.

Visual observations of single and two-phase dividing flow and measurements of the gas-liquid separation behaviour, void fraction and pressure drop were performed in T-junctions having a horizontal run and vertical branch. Both tees used were geometrically similar, in scale 1:4 Plug, slug and stratified flow were observed in horizontal tubes causing mainly a total separation of the gas flow in the branch. For plug and slug flow the diverging flow pattern was stable, while for the stratified flow strong oscillations were measured. Furthermore a calculation method was developed for the prediction of the form-resistance pressure drop, based on the Gardel correlation for single-phase flow taking account of the two-phase flow pattern and the flow restriction in the tee-branch, which gives satisfactory results for all our measured data from both tees.

34172 (INIS-BR-1547) **Criterion for heated pipe design by linear electric resistances.** Bloch, M.; Cruz, J.R.B. Instituto de Engenharia Nuclear, Rio de Janeiro, RJ (Brazil). 1984. 18p. (In Portuguese). (CONF-8410360--: 3. Brazilian symposium on piping and pressure vessels, Salvador, Brazil, 29-31 Oct 1984). Order Number DE89620089/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A criterion for linear eletrical elements instalation on horizontal tubes is obtainned in this work. This criterion is based upon the calculation of the thermal stresses caused by the non uniform temperature distribution in the tube cross section. The finite difference method and the SAP IV computer code are both used in the calculations. The criterion is applied to the thermal circuits of the IEN which has tube diameter varying from phi 1/2 in till phi 8 in.

34173 Bifurcation phenomena in thermal processes and convection. HTD-Vol. 94. AMD-Vol. 89. Bau, H.H.; Bertram, L.A.; Korpela, S.A. 125p. American Society of Mechanical Engineers, New York, NY (1988). (CONF-871234--: ASME winter meeting, Boston, Massachusetts, USA, 13-18 Dec 1987).

This book contains 16 papers. Some of the titles are: Tutorial on elementary bifurcation theory; Stability of convection rolls in porous media; Successive transition of steady states in moderate size containers of air heated below and cooled above; and A bifurcation study of a convention in a two-dimensional saturated porous cavity.

34174 Flow-induced vibrations-1987. PVP - Vol. 122. Au-Yang, M.K.; Chen, S.S. 150p. American Society of Mechanical Engineers, New York, NY (1987). (CONF-870636--: 5. national congress on pressure vessels and piping, San Diego, California, USA, 28 Jun - 2 jul 1987).

This book contains 20 selections. Some of the titles are: Acoustic resonance in heat exchanger tube bundles--Part 1. Physical nature of the phenomenon; Theoretical and experimental studies on heat exchanger U-bend tube bundle vibration characteristics; Experimental model analysis of metallic pipeline conveying fluid; Leakage flow-induced vibration of an eccentric tube-in-tube slip joint; and A study on the vibrations of pipelines caused by internal pulsating flows.

34175 Calculation of forced flow and heat transfer around a cylinder in crossflow. Chun, W. (Univ. of Utah, Salt Lake City, UT (US)); Boehm, R.E. *Numerical Heat Transfer (USA),* 15(1): 101-122 (1989).

A numerical model has been developed to study forced flow and convection heat transfer over a circular cylinder in crossflow. Cases having either a constant heat flux or an isothermal wall are considered. It is assumed that the cylinder is placed in a fluid stream with uniform flow and without any free-stream disturbances. The formulation of the governing equations uses the stream function-vorticity approach along with a mapping transformation between the circular physical geometry and a rectangular computational regime. Solution techniques using the central difference and power law forms are compared. Results for air are obtained up to a Reynolds number of 3480. This is a significant improvement over previous work, which was successful only up to a Reynolds number of 200. In treating the wake region the line of symmetry is assumed, although this is somewhat relaxed by incorporating the radiant Sommerfeld condition for higher Reynolds number cases. The influence of an assumed steady-state behaviour of the wake (which neglected transient shedding phenomena) is shown to be a good approximation to the long-term average of the measured heat transfer data.

34176 Conservation laws from Hamilton's principle for nonlocal thermodynamic equilibrium fluids with heat flow. Sieniutycz, S. (Department of Chemistry, The University of Chicago, 5735 S. Ellis Avenue, Chicago, Illinois 60637(US)); Berry, R. S. *Physical Review [Section] A: General Physics (USA),* 40(1): 348-361 (1 Jul 1989).

Extended thermodynamics of heat-conducting fluids is used to give explicitformulas for non- equilibrium energy density of ideal gas expressed asfunctions of classical variables and the diffusive entropy flux (anonequilibrium variable). A Lagrangian density associated with the energydensity is used to obtain the components of energy-momentum tensor andcorresponding conservation laws on the basis of Hamilton's principle ofstationary action and Noether's theorem. The heat flux appears naturally as aconsequence of a free entropy transfer (independent of mass transfer) and amomentum transport is associated with tangential stresses resulting from thisentropy transfer. The compatibility of the present description with the kinetictheory is shown. Hamilton's principle is extended so that the flux of entropyas well as the fluxes and densities of mass are varied independently. Theconcept of thermal momentum as the derivative of the kinetic potential withrespect to the entropy flux is introduced; this quality plays a fundamentalrole in the extension of Gibbs's equation to describe a nonequilibrium fluidwith heat flux.

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Refer also to citation(s) 33318, 33458, 33462, 33817, 33840, 33921, 34325

34177 (DOE/ER/01198–T14, pp. 35-49) **Collaborative research into the microcharacterization of materials.** Eades, J.A. Illinois Univ., Urbana, IL (USA). Materials Research Lab. Mar 1988. In *Materials Research Laboratory: Renewal proposal for the extension in time and funds.* Order Number DE88013776/JAW. Available from NTIS, PC A99/MF A01; 1.

A central facility for the microcharacterization of materials and their structures is an integral part of the Materials Research Laboratory at the University of Illinois Urbana campus. This is the University of Illinois Center for Microanalysis of Materials. It is intended to serve DOE needs as a repository for microcharacterization techniques and expert information, as a Center for the development of new techniques and instruments in the area of microanalysis of materials, and as a facility to which individuals can come to perform or have performed, particular materials characterization tasks needed for useful materials research. The Center is equipped to fulfill its roles both with regard to major instrumentation and personnel. This program supports the use of the unique instrumental and personnel resources for collaborative research, on a nationwide basis, into seminal areas of materials characterization. Professional scientists, supported by this project, work with users to optimize the way in which the microcharacterization facilities contribute to research projects. These projects are selected by the Center for their fundamental significance and for their relevance to national energy needs. Additional purposes fulfilled by the Center are (a) the design and development of novel materials characterization equipment, (b) the training of personnel to a high level of expertise in a wide range of state-of-the-art materials characterization areas, and (c) development of new characterization methods which allow novel insights into materials problems.

34178 (DOE/ER/01198–T14, pp. 51-59) **Microanalysis of defects and interfaces.** Eades, J.A. Illinois Univ., Urbana, IL (USA). Materials Research Lab. Mar 1988. In *Materials Research Laboratory: Renewal proposal for the extension in time and funds.* Order Number DE88013776/JAW. Available from NTIS, PC A99/MF A01; 1.

This program studies several aspects of the microcharacterization of materials: (1) Defects, interfaces and diffusion in semiconductor heterostructures. By means of a combination of several advanced techniques in the transmission electron microscope a detailed analysis of microstructural aspects of artificial superlattices will be made. This study involves both cathodoluminescence and the atom localization by channeling technique called ALCHEMI. (2) Convergent-beam diffraction from surfaces. The general principles of the experimental aspects of convergent-beam diffraction in RHEED have now been established. This work will carry the field forward both in improving the theoretical understanding and in resolving a series of practical questions. These include the usefulness of the technique for surface symmetry determination, the effect of adsorbed layers, the sensitivity to changes in atomic potential of the surface atoms and diffraction from reconstructed surfaces. (3) Environmental Cell. The construction and installation of the environmental cell for the JEOL 4000EX TEM will continue.

34179 (INIS-mf–11451, pp. 21-25) **Automated ultrasonic testing of nuclear reactor welds and overlays in pre-service and in-service inspections.** Sladky, J. Ceskoslovenska Vedeckotechnicka Spolocnost, Bratislava (Czechoslovakia). Dom Techniky. Mar 1988. (In Czech). (CONF-8803218–: Welding '88 - 3. conference on nondestructive testing of welded joints, Brno, Czechoslovakia, 3-4 Mar 1988). In *Welding '88. Nondestructive testing of welded joints.* Order Number DE89618174/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Since 1982, automatic pre-service and in-service checks are being made of welded joints and overlays on pressure vessels of WWER-440 nuclear reactors in Czechoslovakia. This is being done using the SKODA REACTORTEST TRC facility which is used for checking peripheral welded joints on the pressure vessel, neck joints, overlays in other selected areas of the cylindrical section of the pressure vessel, on radius transitions of the pressure vessel and of necks, and on the cylindrical part of necks, and also for checking the base material in selected parts of the pressure vessel and the base material of the neck extension piece. The tests are of two types, namely tests of peripheral welds and overlays of the cylindrical parts of the pressure vessel, and tests of the necks. Different ultrasonic probe holders are used for the tests, with totally different design. Ultrasonic probes which were initially used were of foreign make while at present, those of Czechoslovak make are used. For each pressure vessel a set of ultrasonic probes is used which should suffice for the life of the vessel. Experience gained so far is being used in work on the project of a new device for testing nuclear reactor presure vessels from the inside. (Z.M.).

34180 (INIS-mf–11451, pp. 26-30) **In-service testing of base material and welded joints in nuclear power plants.** Duba, Z. Ceskoslovenska Vedeckotechnicka Spolocnost, Bratislava (Czechoslovakia). Dom Techniky. Mar 1988. (In Czech). (CONF-8803218–: Welding '88 - 3. conference on nondestructive testing of welded joints, Brno, Czechoslovakia, 3-4 Mar 1988). In *Welding '88. Nondestructive testing of welded joints.* Order Number DE89618174/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

The principles are discussed of the organization, technical and personnel principles of in-service inspection of nuclear power plants with WWER-440 reactors in Czechoslovakia. From the organizational point of view it was determined that the operator was responsible for the preparation, implementation and evaluation of in-service inspections of nuclear power plant components, and selected subcontractors participate in selected inspections and the operator is given the possibility of inviting other specialist organizations in case he feels this is necessary. In-service inspections are currently being carried out prevalently using standard instruments; more than 40 manipulators are currently being developed in the CMEA countries for use in environments exposed to radioactive radiation. Actual crack detection at a nuclear plant with four WWER-440 units is provided by 35 pesonnel who are also responsible for the preparation and evaluation of in-service inspections. (Z.M.).

34181 (INIS-mf–11451, pp. 31-35) **Objective size measurements of defects in welded joint radiography.** Bizek, V.; Bouda, J.; Spunda, J. Ceskoslovenska Vedeckotechnicka Spolocnost, Bratislava (Czechoslovakia). Dom Techniky. Mar 1988. (In Czech). (CONF-8803218–: Welding '88 - 3. conference on nondestructive testing of welded joints, Brno, Czechoslovakia, 3-4 Mar 1988). In *Welding '88. Nondestructive testing of welded joints.* Order Number DE89618174/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

The feasibility was experimentally tested of an objective measurement of the size of defects in welded joints using the CA-1 electronic module. This module in cooperation with a closed television circuit will allow the summation of up to 400 television images

in its memory, it measures and graphically represents the value of the videosignal at various points of the vertical column of the television image. The result of the measurement is a brightness profile proportional to the radiographed thicknesses at a chosen point in the image of the welded joint. An X-ray machine and isotopes Ir-192 and Co-60 were used for radiography. It was found that the device allowed to assess the size of faults in the direction of irradiation much more objectively that a simple comparison of the defect image density in a radiogram or of the defect brightness on a display. The measurement error was determined at 10 to 20% of defect size. (Z.M.). 1 fig.

34182 (INIS-mf–11451, pp. 36-39) **Processing of weld images.** Spunda, J.; Komanec, J.; Pochman, J.; Bizek, V. Ceskoslovenska Vedeckotechnicka Spolocnost, Bratislava (Czechoslovakia). Dom Techniky. Mar 1988. (In Czech). (CONF-8803218–: Welding '88 - 3. conference on nondestructive testing of welded joints, Brno, Czechoslovakia, 3-4 Mar 1988). In *Welding '88. Nondestructive testing of welded joints.* Order Number DE89618174/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Briefly described is the operation of a radioscopy system developed in Czechoslovakia for nondestructive materials testing. The system is based on an image converter with an image intensifier which is capable of effectively processing radiation within the energy range of 30 to 420 keV. The intensified image is picked up in the visible spectrum by a closed circuit television camera. The image is assessed visually using so-called supplementary electronics. The possibilities are discussed of improving the detectability of defects, as are means for evaluating the size of defects and the reconstruction and enhancement of the image. (Z.M.).

34183 (INIS-mf–11451, pp. 40-44) **New techniques and means of X-ray radiography of welded joints.** Sosnin, F.R.; Firstov, V.G. Ceskoslovenska Vedeckotechnicka Spolocnost, Bratislava (Czechoslovakia). Dom Techniky. Mar 1988. (In Slovak). (CONF-8803218–: Welding '88 - 3. conference on nondestructive testing of welded joints, Brno, Czechoslovakia, 3-4 Mar 1988). In *Welding '88. Nondestructive testing of welded joints.* Order Number DE89618174/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

A brief description is presented of instruments developed in the USSR for X-ray inspection of welded joints. Heavy current instruments of the RAP cable type provide high stability of X-ray radiation. Pulsed radiation instruments allow to obtain in one single 20 to 50 ns pulse, X-ray radiation of up to 100 mR and more, which allows to significantly extend the use of radiation inspection. RI-60TK X-ray television radioscopy instruments make it possible to inspect welded joints in thicknesses of 6 to 30 mm (of steel) with a sensitivity of 1.5 to 2% under normal conditions and of 3 to 4% in an object moving at 3 m/min. Also developed have been X-ray electroradiographic instruments of the ERGA type which use selenium plates replacing X-ray film. (Z.M.). 3 tabs.

34184 (INIS-mf–11451, pp. 50-53) **Radiography of nozzle-to-pressure-vessel welds.** Jedrzejewski, A. Ceskoslovenska Vedeckotechnicka Spolocnost, Bratislava (Czechoslovakia). Dom Techniky. Mar 1988. (In Slovak). (CONF-8803218–: Welding '88 - 3. conference on nondestructive testing of welded joints, Brno, Czechoslovakia, 3-4 Mar 1988). In *Welding '88. Nondestructive testing of welded joints.* Order Number DE89618174/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

For radiographic testing of welded joints connecting nozzles with the nuclear reactor pressure vessel, methods are used with regard to required accuracy where the radiation source is eccentric, off the axis of the source-object-film configuration. The number of required exposures primarily depends on the shape of the nozzle mouth. Briefly discussed are problems related to the insertion of the film and the gradual positioning of the source for individual exposures. These problems should be resolved by the Rotatron instrument which is currently being developed and which will provide the necessary motion of the radiation source and will allow the radiographic image of the whole joint to be made on one single film strip. (Z.M.). 5 figs.

34185 (INIS-mf–11451, pp. 54-59) **Automatic X-ray radiography of welded joints.** Richter, H.U.; Linke, D.; Siems, K.; Kruse, H.; Schuetze, E. Ceskoslovenska Vedeckotechnicka Spolocnost, Bratislava (Czechoslovakia). Dom Techniky. Mar 1988. (In Slovak). (CONF-8803218–: Welding '88 - 3. conference on nondestructive testing of welded joints, Brno, Czechoslovakia, 3-4 Mar 1988). In *Welding '88. Nondestructive testing of welded joints.* Order Number DE89618174/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

The X-ray testing robot ZIS 995 is used for testing small welded parts such as tube adapters 25 to 400 mm in diameter and 2.5 to 16 mm in wall thickness, and bends of 180deg, 57 to 219 mm in diameter with wall thicknesses of 5 to 16 mm. The device provides automatic optimal positioning of the X-ray source and of the X-ray image intensifier. The main parts of the device consist in a 160 kV X-ray instrument made in the FRG, an image intensifier ZOX 193 KM manufactured in Czechoslovakia and an RFA 4010 camera manufactured in the GDR. Tests are being run of computer processing of the X-ray image using the BVS 6472 system manufactured by Robotron, GDR. (Z.M.). 3 figs., 1 ref.

34186 (INIS-mf–11451, pp. 60-64) **Classification of industrial radiographic films.** Ciorau, P.; Bocaneala, M.; Loechli, A.; Mandrila, S.; Truta, T. Ceskoslovenska Vedeckotechnicka Spolocnost, Bratislava (Czechoslovakia). Dom Techniky. Mar 1988. (In Slovak). (CONF-8803218–: Welding '88 - 3. conference on nondestructive testing of welded joints, Brno, Czechoslovakia, 3-4 Mar 1988). In *Welding '88. Nondestructive testing of welded joints.* Order Number DE89618174/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

The results are discussed of experiments oriented to a new classification of films for industrial radiography. The SEIFERT ISOVOLT 420 kV X-ray instrument was used to investigate the relative sensitivity and the quality factor for AZOMURES and AGFA-GEVAERT films. Based on the results, a system is proposed of the classification of film quality based on statistical EPS values for manual film processing. (Z.M.). 2 figs., 2 tabs., 8 refs.

34187 (INIS-mf–11451, pp. 82-86) **Highly damped ultrasonic angular probes for austenitic steel testing.** Schurig, C.; Goerner, W. Ceskoslovenska Vedeckotechnicka Spolocnost, Bratislava (Czechoslovakia). Dom Techniky. Mar 1988. (In Czech). (CONF-8803218–: Welding '88 - 3. conference on nondestructive testing of welded joints, Brno, Czechoslovakia, 3-4 Mar 1988). In *Welding '88. Nondestructive testing of welded joints.* Order Number DE89618174/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

The causes are discussed of shortcomings which appear when ultrasonic testing methods and devices which have been developed for ferritic steels, are applied in testing austenitic and other coarse-grain materials. The shortcomings consist in that the spectrum of grain size of the materials causes great dispersion of the ultrasound pulse which passes through them and that the dendritic structure in welded joints of thick walled parts causes a strong directional dependence of the velocity of ultrasound propagation inside the weld. In tests of austenitic materials, ultrasound should be introduced into the material such that it will only pass through one material edge and the joint must be such that the divide between the weld and the base material is planar. The parameters are presented of ultrasonic probes developed for automated testing of welds on thick walled austenitic parts. (Z.M.). 4 refs.

34188 (INIS-mf–11451, pp. 120-125) **Acoustic emission used to investigate heat treatment of overlays.** Cermak, F.; Kovarik, R. Ceskoslovenska Vedeckotechnicka Spolocnost, Bratislava (Czechoslovakia). Dom Techniky. Mar 1988. (In Czech). (CONF-8803218–: Welding '88 - 3. conference on nondestructive testing of welded joints, Brno, Czechoslovakia, 3-4 Mar 1988). In *Welding '88. Nondestructive testing of welded joints.* Order Number DE89618174/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

The reason for the rare use of acoustic emission in testing welded joints on thick-walled pressure vessels and pipe systems is the necessity of separating interfering acoustic signals from signals due to the defect. The moment of the initiation of the crack under the overlay was therefore experimentally detected by which it would be possible to assess the kinetics and the mechanism of its propagation. 10GN2MFA steel was chosen for the experiment in which

cracks under the overlay were found during the annealing of test plates. An apparatus by Dunegan was used for measuring the acoustic emission. The results of the experiments are briefly discussed. (Z.M.). 3 figs., 2 refs.

34189 (INIS-mf–11982 vp.) **Towards a philosophy of inspection.** Currie, T. (Principal, Currie and Associates, London (UK)). Staatliche Materialpruefungsanstalt, Stuttgart (Germany, F.R.). 1987. (CONF-8710410–: 13. MPA seminar on safety and reliability of pressure components: the contribution of component and large specimen testing to structural integrity assessment methodology, Stuttgart, Germany, F.R., 8-9 Oct 1987). In *Safety and reliability of pressure components with special emphasis on the contribution of component and large specimen testing to structural integrity assessment methodology. Vol. 1. Fracture mechanics, dynamic loading, nondestructive testing, radiation embrittlement.* Order Number DE89783126/JAW. Available from NTIS (US Sales Only), PC A99/MF A01.

The theme of this paper is that we are moving away from that state of affairs, and that we now possess the technology to set inspection targets, to validate the capability of the techniques, procedures and operators to meet those targets, and to provide assurance that the inspection process as performed on the job has attained the targets set. It is the author's contention that, since all of those aims are now attainable, or are currently being demonstrated in the UK to be 'reasonably practicable' in the course of the Sizewell 'B' project, they should be incorporated as soon a possible in the pressure vessel codes, and after a suitable period of use and experience, perhaps in other vessel codes.

34190 (INIS-mf–11982, pp. 11.1-11.23) **Progress in numerical modelling of dynamic specimen behaviour in the L.D.T.F.** Jones, P.M. (Commission of the European Communities, Ispra (Italy). Joint Research Centre); Casadei, F.; Halleux, J.P. Staatliche Materialpruefungsanstalt, Stuttgart (Germany, F.R.); Commission of the European Communities, Ispra (Italy). Joint Research Centre. 1987. (CONF-8710410–: 13. MPA seminar on safety and reliability of pressure components: the contribution of component and large specimen testing to structural integrity assessment methodology, Stuttgart, Germany, F.R., 8-9 Oct 1987). In *Safety and reliability of pressure components with special emphasis on the contribution of component and large specimen testing to structural integrity assessment methodology. Vol. 1. Fracture mechanics, dynamic loading, nondestructive testing, radiation embrittlement.* Order Number DE89783126/JAW. Available from NTIS (US Sales Only), PC A99/MF A01.

Numerical modelling in support of the Large Dynamic Test Facility (L.D.T.F.) test programme has continued with improvements in the 1-D model presented at the 12th MPA Seminar and with a 2-D plane stress model now operational for flat steel tensile specimens. 2-D analysis of axisymmetric specimens is also in progress and simulation of reinforced concrete beams has started. The models developed and validated in the course of this work are being incorporated in PLEXIS-3C, a new computer code that is being developed in collaboration with CEA.

34191 (INIS-mf–11982, pp. 12.1-12.34) **Recent developments and results of L.D.T.F. tests on steel and concrete specimens.** Delzano, C. (Commission of the European Communities, Ispra (Italy). Joint Research Centre); Gutierrez, E.; Jones, P.M.; Verzeletti, G. Staatliche Materialpruefungsanstalt, Stuttgart (Germany, F.R.); Commission of the European Communities, Ispra (Italy). Joint Research Centre. 1987. (CONF-8710410–: 13. MPA seminar on safety and reliability of pressure components: the contribution of component and large specimen testing to structural integrity assessment methodology, Stuttgart, Germany, F.R., 8-9 Oct 1987). In *Safety and reliability of pressure components with special emphasis on the contribution of component and large specimen testing to structural integrity assessment methodology. Vol. 1. Fracture mechanics, dynamic loading, nondestructive testing, radiation embrittlement.* Order Number DE89783126/JAW. Available from NTIS (US Sales Only), PC A99/MF A01.

The recent developments carried out on the Large Dynamic Test Facility (L.D.T.F.) both in its geometry and instrumentation are presented. The streak film method has been added to the strain-gauge and Moire fringe techniques to extend the strain-measuring range beyond the onset of necking in steel samples (AISI-316 L steel). New results are presented comparing 'static' and dynamic tests on plain and welded steel specimens. The L.D.T.F. has also been modified to allow tests on beams subjected to bending. The results of the first tests on heavy section reinforced concrete beams of 2 and 3 m length are presented.

34192 (INIS-mf–11982, pp. 13.1-13.20) **History, development and application of a uniformly applied load wide plate testing machine.** Quirk, A. (UKAEA Risley Nuclear Power Development Establishment, Culcheth. Safety and Reliability Directorate); Bevitt, E. Staatliche Materialpruefungsanstalt, Stuttgart (Germany, F.R.); UKAEA Risley Nuclear Power Development Establishment, Culcheth (UK). Safety and Reliability Directorate. 1987. (CONF-8710410–: 13. MPA seminar on safety and reliability of pressure components: the contribution of component and large specimen testing to structural integrity assessment methodology, Stuttgart, Germany, F.R., 8-9 Oct 1987). In *Safety and reliability of pressure components with special emphasis on the contribution of component and large specimen testing to structural integrity assessment methodology. Vol. 1. Fracture mechanics, dynamic loading, nondestructive testing, radiation embrittlement.* Order Number DE89783126/JAW. Available from NTIS (US Sales Only), PC A99/MF A01.

The system as described and currently employed is arranged to apply a uniform load distribution but by control of the pressure applied to each individual pair of loading units any desired load distribution could be achieved. The machine could be converted if necessary into a biaxial stressing unit. Transverse loading could be applied in a similar manner to the vertical loading by the provision of slotted flanges at the vertical edges of the test plates loaded by loading units placed either inboard or outboard of the existing vertical units their location depending on the desired ratio of the two mutually perpendicular stresses. Owing to the cheapness of the basic components, standard hydraulic jacks, cast steel compression members and bearings etc, together with the free-standing design requiring no elaborate foundations and only simple lifting equipment the machine provides a relatively inexpensive testing facility providing realistic loading conditions.

34193 (INIS-mf–11982, pp. 14.1-14.16) **Load bearing and deformation behaviour of dynamically tested wide plate specimens.** Julisch, P. (Stuttgart Univ. (Germany, F.R.). Staatliche Materialpruefungsanstalt); Haedrich, H.J.; Stadtmueller, W.; Sturm, D. Staatliche Materialpruefungsanstalt, Stuttgart (Germany, F.R.). 1987. (In German). (CONF-8710410–: 13. MPA seminar on safety and reliability of pressure components: the contribution of component and large specimen testing to structural integrity assessment methodology, Stuttgart, Germany, F.R., 8-9 Oct 1987). In *Safety and reliability of pressure components with special emphasis on the contribution of component and large specimen testing to structural integrity assessment methodology. Vol. 1. Fracture mechanics, dynamic loading, nondestructive testing, radiation embrittlement.* Order Number DE89783126/JAW. Available from NTIS (US Sales Only), PC A99/MF A01.

The influences of high strain rates on the loading and deformation behaviour of pressurized pipe and vessel components for nuclear power stations were investigated. For this, destructive tensile tests were conducted with various loading rates on wide-plate specimens using a shock-loading machine. The motive force is supplied by an explosive charge; the maximum test force is 12 MN. With this system, a piston displacement of 20 mm can be achieved at trigger velocities of approx. 25 m/s. The maximum trigger velocity lies at around 60 m/s. Quasi-static and dynamic tensile tests were conducted at ambient temperatures with a total of 17 wide plate specimens of the material X 6 CrNi 18 11. Whilst some possessed a longitudinal and transverse weld, some specimens were completely free from joints for basic material investigations.

34194 (INIS-mf–11982, pp. 16.1-16.25) **ALOK-application for inservice inspections.** Kappes, W. (Fraunhofer-Institut fuer Zerstoerungsfreie Pruefverfahren, Saarbruecken (Germany, F.R.)); Stanger, H.K.; Hoeh, F.; Heumueller, R. Staatliche Materialpruefungsanstalt, Stuttgart (Germany, F.R.); Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forschung e.V., Saarbruecken (Germany, F.R.). Inst. fuer Zerstoerungsfreie Pruefverfahren; Kraftwerk

Union A.G., Erlangen (Germany, F.R.). 1987. (In German). (CONF-8710410–: 13. MPA seminar on safety and reliability of pressure components: the contribution of component and large specimen testing to structural integrity assessment methodology, Stuttgart, Germany, F.R., 8-9 Oct 1987). In *Safety and reliability of pressure components with special emphasis on the contribution of component and large specimen testing to structural integrity assessment methodology. Vol. 1. Fracture mechanics, dynamic loading, nondestructive testing, radiation embrittlement.* Order Number DE89783126/JAW. Available from NTIS (US Sales Only), PC A99/MF A01.

The ALOK technique makes use of the different echo signal transit times which occur when traversing the emitter across a component under inspection. The evaluation of the ultrasonic data obtained by repeated inservice inspections of pre-detected material faults may be simplified by comparing the local transit time curve identities, characterizing these defective zones. Changes in the transit time patterns allow a component's inservice material defect growth to be detected and quantified.

34195 (INIS-mf–11982, pp. 18.1-18.21) **Phased array concept for the ultrasonic inservice inspection at the spherical bottom of BWR-pressure vessels.** Brekow, G. (Bundesanstalt fuer Materialforschung und -pruefung, Berlin (Germany, F.R.)); Wuestenberg, H.; Moehrle, W.; Schulz, E. Staatliche Materialpruefungsanstalt, Stuttgart (Germany, F.R.); Bundesanstalt fuer Materialforschung und -pruefung, Berlin (Germany, F.R.). 1987. (In German). (CONF-8710410–: 13. MPA seminar on safety and reliability of pressure components: the contribution of component and large specimen testing to structural integrity assessment methodology, Stuttgart, Germany, F.R., 8-9 Oct 1987). In *Safety and reliability of pressure components with special emphasis on the contribution of component and large specimen testing to structural integrity assessment methodology. Vol. 1. Fracture mechanics, dynamic loading, nondestructive testing, radiation embrittlement.* Order Number DE89783126/JAW. Available from NTIS (US Sales Only), PC A99/MF A01.

The required enhancement of the integrity assessment of perforated reactor vessel base plates has been achieved by a phased-array concept. This technique improvement is based on the fact that the quantity of individual resonant components is reduced whilst increasing the amount of web regions which fall into the sonic range of the pivoted detector due to the larger apex angle scope which the phased array concept provides. A mathematical model concept was initially developed to determine the acoustic irradiation angle and squiat angle ranges to be detected by the phased-array scanner. A prototype of this device has been constructed and tested with a steel sample possessing different perforations and experimental reflectors in order to assess and optimize the new system. The results of these investigations are presented together with those of an application at the nuclear power station in Brunsbuettel.

34196 (INIS-mf–11982, pp. 19.1-19.21) **Results by an advanced manual NDT-system.** Weiss, R. (Fraunhofer-Institut fuer Zerstoerungsfreie Pruefverfahren, Saarbruecken (Germany, F.R.)); Eisel, A. Staatliche Materialpruefungsanstalt, Stuttgart (Germany, F.R.); Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forschung e.V., Saarbruecken (Germany, F.R.). Inst. fuer Zerstoerungsfreie Pruefverfahren. 1987. (In German). (CONF-8710410–: 13. MPA seminar on safety and reliability of pressure components: the contribution of component and large specimen testing to structural integrity assessment methodology, Stuttgart, Germany, F.R., 8-9 Oct 1987). In *Safety and reliability of pressure components with special emphasis on the contribution of component and large specimen testing to structural integrity assessment methodology. Vol. 1. Fracture mechanics, dynamic loading, nondestructive testing, radiation embrittlement.* Order Number DE89783126/JAW. Available from NTIS (US Sales Only), PC A99/MF A01.

This system provides an automatic recording of the test data and scanner position for the manual ultrasonic integrity assessment with common ultrasonic devices. Furthermore, it is possible to read-in and process the test data of the fluorescent penetration tests, the magnetic particle inspection and the potential collector tests. The experience gained from this system from applications concerning the research and development projects SEP - vessel tests, HDR and PISC II is presented.

34197 (INIS-mf–11982, pp. 20.1-20.22) **Manual and mechanized ultrasonic inspection of large components in respect of defect estimation by fracture mechanics.** Heinrich, D. (MAN Gutehoffnungshuette GmbH, Nuernberg (Germany, F.R.). Bereich Thermische Kraftanlagen); Mayer, K.H.; Mueller, G.; Prestel, W. Staatliche Materialpruefungsanstalt, Stuttgart (Germany, F.R.). 1987. (In German). (CONF-8710410–: 13. MPA seminar on safety and reliability of pressure components: the contribution of component and large specimen testing to structural integrity assessment methodology, Stuttgart, Germany, F.R., 8-9 Oct 1987). In *Safety and reliability of pressure components with special emphasis on the contribution of component and large specimen testing to structural integrity assessment methodology. Vol. 1. Fracture mechanics, dynamic loading, nondestructive testing, radiation embrittlement.* Order Number DE89783126/JAW. Available from NTIS (US Sales Only), PC A99/MF A01.

The numerical reconstruction techniques offer - in contrast to conventional methods - an improved presentation, particularly as far as isolated and resolvable defects are concerned. The accuracy of the reconstruction mainly depends in the ratio of the wave-length to the defect size, the modulator diameter of the scanner, the consistency of the sonic velocity and the occurrence of wave-splitting. Due to certain boundary conditions, the test frequency and modulator size cannot, however, be arbitrarily varied. The resolution of the echotomography is, for present practical purposes, 3-5 mm. For LSAF techniques, this is assumed to be of the same order for large acoustic depths. The possibilities and limits of the assessment of the ultrasonic data and the fracture-mechanical consequences of these results are demonstrated with the aid of large-scale rotation symmetric forged components possessing production defects.

34198 (INIS-mf–11982, pp. 21.1-21.20) **Automated analysis of stress states using ultrasonic techniques.** Schneider, E. (Fraunhofer-Institut fuer Zerstoerungsfreie Pruefverfahren, Saarbruecken (Germany, F.R.)); Herzer, R. Staatliche Materialpruefungsanstalt, Stuttgart (Germany, F.R.); Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forschung e.V., Saarbruecken (Germany, F.R.). Inst. fuer Zerstoerungsfreie Pruefverfahren. 1987. (In German). (CONF-8710410–: 13. MPA seminar on safety and reliability of pressure components: the contribution of component and large specimen testing to structural integrity assessment methodology, Stuttgart, Germany, F.R., 8-9 Oct 1987). In *Safety and reliability of pressure components with special emphasis on the contribution of component and large specimen testing to structural integrity assessment methodology. Vol. 1. Fracture mechanics, dynamic loading, nondestructive testing, radiation embrittlement.* Order Number DE89783126/JAW. Available from NTIS (US Sales Only), PC A99/MF A01.

The automatic analysis of stresses in components using ultrasonic techniques is based on the measurement of the stress-dependent transition times of the ultrasonic waves. As with the zero-tracking technique, the IzfP prototype measures these transition times with a high degree of accuracy. Corresponding changes in the evaluation program of the prototype allow textures, creep damage and porosities to be detected. The EMUS converter which was developed for the stress analysis is discussed in brief.

34199 (INIS-mf–11982, pp. 22.1-22.20) **Evaluation of indications at long distance and underclad findings.** Gebhardt, W. (Fraunhofer-Institut fuer Zerstoerungsfreie Pruefverfahren, Saarbruecken (Germany, F.R.)); Schmitz, V.; Bernus, L. v.; Kroening, M. Staatliche Materialpruefungsanstalt, Stuttgart (Germany, F.R.); Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forschung e.V., Saarbruecken (Germany, F.R.). Inst. fuer Zerstoerungsfreie Pruefverfahren; Kraftwerk Union A.G., Erlangen (Germany, F.R.). 1987. (In German). (CONF-8710410–: 13. MPA seminar on safety and reliability of pressure components: the contribution of component and large specimen testing to structural integrity assessment methodology, Stuttgart, Germany, F.R., 8-9 Oct 1987). In *Safety and reliability of pressure components with special emphasis on the contribution of component and large specimen testing to structural integrity assessment methodology. Vol. 1.*

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Especially in conjunction with 'large sonic distances' i.e. in the case of a low sensitivity for crack tip determination, or inadequate focussing at the location of the reflector, analysis techniques become necessary in order to correct the results of standard inspections which are usually too conservative. Both manual analysis techniques are available, being based on focussing scanners or transit time reconstructive methods and computer-assisted techniques which function according to the synthetic aperture principle. ALOK and SAFT measurements were conducted on volume defects and underload faults. A comparison of the results shows that due to the complete B-range depiction, the computer-assisted techniques are of advantage in comparison to manual methods, since they allow a better interpretation of the test results, whereby in individual instances, assessment errors may be avoided.

34200 (INIS-mf–11982, pp. 23.1-23.20) **Early detection of creep damage by ultrasonic techniques.** Willems, H. (Fraunhofer-Institut fuer Zerstoerungsfreie Pruefverfahren, Saarbruecken (Germany, F.R.)). Staatliche Materialpruefungsanstalt, Stuttgart (Germany, F.R.); Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forschung e.V., Saarbruecken (Germany, F.R.). Inst. fuer Zerstoerungsfreie Pruefverfahren. 1987. (In German). (CONF-8710410–: 13. MPA seminar on safety and reliability of pressure components: the contribution of component and large specimen testing to structural integrity assessment methodology, Stuttgart, Germany, F.R., 8-9 Oct 1987). In *Safety and reliability of pressure components with special emphasis on the contribution of component and large specimen testing to structural integrity assessment methodology. Vol. 1. Fracture mechanics, dynamic loading, nondestructive testing, radiation embrittlement.* Order Number DE89783126/JAW. Available from NTIS (US Sales Only), PC A99/MF A01.

The possibility of using the US-technique to characterize creep damage in the pin-porosity stage were investigated. Above all, the influence of the porosity on the US sonic velocity and sonic extinction parameters is described. The results of US measurements using creep-damaged materials are presented in addition to measurements concerning long-term creep samples (alloy 800 H) and investigations into service-loaded 14 MoV 63 steel.

34201 (INIS-mf–11982, pp. 24.1-24.30) **Intermediate size vessel ZB 2 - manufacturing of the vessel, testing procedure and crack investigations.** Gertkemper, H. (Stuttgart Univ. (Germany, F.R.). Staatliche Materialpruefungsanstalt); Knoch, P.; Maier, H.J.; Fischer, H.; Katerbau, K.H. Staatliche Materialpruefungsanstalt, Stuttgart (Germany, F.R.). 1987. (In German). (CONF-8710410–: 13. MPA seminar on safety and reliability of pressure components: the contribution of component and large specimen testing to structural integrity assessment methodology, Stuttgart, Germany, F.R., 8-9 Oct 1987). In *Safety and reliability of pressure components with special emphasis on the contribution of component and large specimen testing to structural integrity assessment methodology. Vol. 1. Fracture mechanics, dynamic loading, nondestructive testing, radiation embrittlement.* Order Number DE89783126/JAW. Available from NTIS (US Sales Only), PC A99/MF A01.

The test vessel was constructed from 14 MnNiMo 6 5 with a prepared defective 20 MnMoNi 5 5 segment. The sonic emission analysis technique used during various inservice loadings (i.e. cyclic loading, internal pressure tests) delivered reliable indications of cyclic crack growth. Corrosion-based crack growth could not be verified during the hot static pressure phases.

34202 (INIS-mf–11982, pp. 25.1-25.30) **Acoustic emission results within the ZB2-programme.** Deuster, G. (Fraunhofer-Institut fuer Zerstoerungsfreie Pruefverfahren, Saarbruecken (Germany, F.R.)); Waschkies, E.; Maier, H.J.; Knoch, P. Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forschung e.V., Saarbruecken (Germany, F.R.). Inst. fuer Zerstoerungsfreie Pruefverfahren; Staatliche Materialpruefungsanstalt, Stuttgart (Germany, F.R.). 1987. (In German). (CONF-8710410–: 13. MPA seminar on safety and reliability of pressure components: the contribution of component and large specimen testing to structural integrity assessment methodology, Stuttgart, Germany, F.R., 8-9 Oct 1987). In *Safety and reliability of pressure components with special emphasis on the contribution of component and large specimen testing to structural integrity assessment methodology. Vol. 1. Fracture mechanics, dynamic loading, nondestructive testing, radiation embrittlement.* Order Number DE89783126/JAW. Available from NTIS (US Sales Only), PC A99/MF A01.

This report presents the results of the vessel investigations of the MPA Stuttgart and the IzfP Saarbruecken which were aimed at improving the information to be gained from sonic emission test for fault-finding and classification. The investigations were focussed on the quantification of the ability and the limits of detection together with the improvement of the interpretation of the data. The investigations were conducted on a 14 MnNiMo 6 5 vessel with a defective patch of 20 MnMoNi 5 5 under practice-orientated loadings.

34203 (INIS-mf–11982, pp. 26.1-26.26) **Fracture mechanics interpretation of acoustic emission results.** Neubrech, G.E. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projektbereich Heissdampfreaktor - Sicherheitsprogramm/Handhabungstechnik); Walte, F.; Waschkies, E. Staatliche Materialpruefungsanstalt, Stuttgart (Germany, F.R.); Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projektbereich Heissdampfreaktor - Sicherheitsprogramm; Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forschung e.V., Saarbruecken (Germany, F.R.). Inst. fuer Zerstoerungsfreie Pruefverfahren. 1987. (In German). (CONF-8710410–: 13. MPA seminar on safety and reliability of pressure components: the contribution of component and large specimen testing to structural integrity assessment methodology, Stuttgart, Germany, F.R., 8-9 Oct 1987). In *Safety and reliability of pressure components with special emphasis on the contribution of component and large specimen testing to structural integrity assessment methodology. Vol. 1. Fracture mechanics, dynamic loading, nondestructive testing, radiation embrittlement.* Order Number DE89783126/JAW. Available from NTIS (US Sales Only), PC A99/MF A01.

The observation of crack propagation processes during cyclic thermal shock experiments with a corrosive medium on a clad pressure vessel plange of a superheated steam-cooled reactor was conducted with a sonic emission system with which the sonic emission reflections of the crack propagation and other processes (such as crack friction) could be automatically classified. This classification is conducted on the basis of a statistic model, whereby for each sonic reflection, different signal parameters (rise time, duration and energy of the signal) are taken into consideration. From the sonic test results of the thermal shock-loaded flange experiments, an important new conclusion concerning the crack propagation mechanism seems possible. This is that the crack growth is not primarily dependent on the load delta-K, but only occurs during a short period of unfavourable temperature. These deductions are to be investigated in detail in aimed future experiments.

34204 (PB–89-856165/XAB) **Tribology: properties of materials. January 1970-February 1989 (Citations from the COMPENDEX data base). Report for January 1970-February 1989.** National Technical Information Service, Springfield, VA (USA). Feb 1989. 87p. Available from NTISPC N01/MF N01.

Supersedes PB–85-863819.

This bibliography contains citations concerning tribological properties of composite materials, plastics, metals and ceramics. Test apparatus and design techniques for evaluating the effects of temperature, load, sliding speed, surface contact, lubricants and additives on tribological behavior of materials are discussed. Tribological assessment of materials and wear processes on tribologically loaded material surfaces are considered. (This updated bibliography contains 163 citations, 81 of which are new entries to the previous edition.)

34205 (RISO-M–2770) **Dimensional measurements from neutron radiographs.** Domanus, J.C. Risoe National Lab., Roskilde (Denmark). Jan 1989. 17p. (CONF-890478–: 12. world conference on non-destructive testing, Amsterdam, Netherlands, 23-28 Apr 1989). Order Number DE89620175/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Neutron radiography (NR) is mainly used for the control of explosives and nuclear fuel elements. It is often necesaary to determine

the dimensions of the object under control from neutron radiographs. To check the accuracy of dimensional measurements obtainable with all techniques used in NR, a test program was performed by the Euratom Neutron Radiography Working Group (NRWG). For that purpose a calibration fuel pin (CFP), designed and produced at Risoe, was used. The CFP was thereafter neutron radiographed at 11 NR facilities in 7 NR centers of the 6 countries participating in the NRWG test program. 30 different film/converter combinations were used. 61 different dimensions were measured, using a profile projector and a travelling microdensitometer. Altogether about 25,000 dimensional measurements were made. The accuracy of those measurements was assessed by comparing the measured with the calibrated dimensions and calculating standard deviations. (author) 5 ills., 17 refs.

34206 (SAND–89-0490C) **Micromechanical characterization of near-surface layers.** Bourcier, R.J. Sandia National Labs., Albuquerque, NM (USA). 1989. 21p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890748–6: Microbeam Analysis Society meeting, Asheville, North Carolina, USA, 16-21 Jul 1989). Order Number DE89008710/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This paper reviews several techniques available to the experimenter to characterize the mechanical properties of near surface layers of engineering materials. The test methods examined are: micro-tensile testing, bulge testing, ultra-low load indentation testing, and microfabricated test structures. The applicability of these techniques as well as their advantages and difficulties are examined. Special emphasis is given to recent developments in ultra-low load indentation testing and microfabricated test structures. 61 refs., 2 figs.

34207 (SAND–89-0633C) **Materials analysis with nuclear microprobes: Superconductors and buried conductors.** Barbour, J.C.; Doyle, B.L. Sandia National Labs., Albuquerque, NM (USA). 1989. 12p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890748–5: Microbeam Analysis Society meeting, Asheville, North Carolina, USA, 16-21 Jul 1989). Order Number DE89008580/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Nuclear microprobe analysis (NMA) is a unique form of microbeam analysis in that it combines high lateral resolution with the high depth resolution techniques of conventional ion beam analysis (IBA) to nondestructively determine sample composition in three dimensions. By using depth sensitive IBA techniques (e.g., Rutherford Backscattering Spectrometry (RBS), Enhanced Backscattering Spectrometry (EBS) or Elastic Recoil Detection (ERD)), NMA finds its greatest utility in analyses requiring the following information: (1) 1–100 ppM sensitivity, (2) nondestructive three-dimensional depth profiling, and (3) quantitative light element analysis (e.g., the first two rows of the periodic table). This paper demonstrates the continuing evolution of NMA capabilities through two examples. First, the unique capabilities afforded NMA are shown in a simple yet accurate method to measure both oxygen and metal atom concentrations in Y-Ba-Cu-O alloys with micro-area ion beam analysis. Second, a NMA of buried tungsten lines in a silicon wafer demonstrates the complementary nature of information determined by NMA and scanning electron microscopy (SEM). 9 refs., 2 figs.

34208 Electroformed nickel frangible nose cone. Johnson, H.R. (Sandia National Labs., Livermore, CA (US)); Bonivert, W.D.; Johnsen, H.A.; Hachman, J.T. v.v of Proceedings of the Electrochemical Society Fall meeting: Extended abstracts. Volume 87-2. The Electrochemical Society, Pennington, NJ (1987). (CONF-871027–: 172. meeting of the Electrochemical Society, Honolulu, Hawaii, USA, 18-23 Oct 1987).

The authors' laboratory is interested in developing a projectile that will sink rapidly after water entry following air flight. One possible design includes a nose cone that would have a fixed aerodynamic shape during launch and flight and yet be frangible upon water impact, exposing a stable, hydrodynamic, blunt nose. Initial efforts were expended to develop cloth-resin and ceramic nose fairings, but the fabrication techniques had temperature and cost consideration that made them unattractive. Electroforming techniques were chosen as the primary method for fabricating test parts because of their capability to allow tailoring of specific properties of the electro-deposited materials.

34209 Overview of development and application of acoustic emission methods in the United States. Hutten, P.H. (Battelle Pacific Northwest Labs., Richland, WA (USA)). *Nuclear Engineering and Design (Netherlands),* 113(1): 59-69 (Apr 1989). DOE Contract AC06-76RL01830.

Beneficial uses being made of acoustic emission (AE) technology for flaw or fault detection both inside of and outside of the nuclear industry tend to be obscured by some of the earlier disappointing efforts to utilize the technology. The objective of this paper is to counter that tendency by providing an overview of a variety of AE applications being made in the United States. In addition to nuclear power applications, the paper discusses applications in other nuclear areas, fossil power plant applications, and other industrial uses including aircraft monitoring. Major AE research and development programs in progress in the United States are also summarized.

4208 Electronic Circuits and Devices

Refer also to citation(s) 33407, 33708, 33967, 33985, 33987, 33992, 33993, 34009, 34017, 34022, 34026, 34027, 34032, 34034, 34360, 34361, 35332, 35333

34210 (LA-UR–89-490) **Radiation evaluation of several complex very large scale integration circuits.** Spraggins, S.A.; Roeske, S.B.; Browning, J.S.; Holtkamp, D.B. Los Alamos National Lab., NM (USA). 1989. 4p. Sponsored by DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-890723–4: 26. annual conference on nuclear and space radiation effects, Marco Island, Florida, USA, 24-28 Jul 1989). Order Number DE89007985/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This paper presents the results of an evaluation of the radiation tolerance for natural space environments of several complex microprocessors, coprocessors and associated peripheral components; as well as an analog to digital converter and a power MOSFET. 4 refs., 1 fig.

34211 (LBL–26254) **Proposed thin film electronics for a-Si:H PIXEL detectors.** Perez-Mendez, V.; Cho, G.; Fujieda, I.; Kaplan, S.N.; Qureshi, S.; Street, R.A. Lawrence Berkeley Lab., CA (USA). Apr 1989. 29p. Sponsored by DOE Energy Research. DOE Contract AC03-76SF00098. Order Number DE89013410/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

We describe a proposed 2-D PIXEL detector and its electronic circuit. The dimensions of each PIXEL are 300 x 300 μm^2. Signal-to-noise ratio is in excess of 8 when connected to an a-Si:H TFT with g_m = 3, and 10 when a polysilicon PMOSFET with g_m = 50 is used. For both cases we assume an RC-CR shaping time of 1 μsec. The signal amplification and readout circuit will be placed under the detector and can consist of 5 or 6 FETs and some passive elements. 17 refs., 12 figs., 6 tabs.

34212 (SAND—88-3475C) **A one microsecond, thirty-five kilojoule, one hertz pulse generator.** Clark, R.S.; Rinehart, L.R.; Buttram, M.T.; Green, D.L. Sandia National Labs., Albuquerque, NM (USA). 1989. 14p. Sponsored by Department of Defense. DOE Contract AC04-76DP00789. (CONF-890665–7: 7. Institute of Electrical and Electronics Engineers pulsed power conference, Monterey, California, USA, 12-14 Jun 1989). Order Number DE89013074/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A repetitive high-voltage pulser has been developed at Sandia National Laboratories that will drive a vacuum diode for electron beam production. It is a 1-μs, 200-kV, 1-ohm, 35-kJ unit that is designed to operate in the 1-10 Hz range (this report will cover the 1-Hz operation). The design concept utilizes a pulse forming network (PFN) to form the output waveshape. The pulser is developed in a modular concept that will allow series/parallel operation of the PFNs to meet changing energy and/or voltage needs. Achieving sufficiently low inductance is generally the chief design challenge in producing a low-impedance PFN. Because it allows the greatest amount of inductance in the circuit, the Guillemin type "C" PFN is used in each module. Several capacitive stages are charged to $\pm$ 100 kV (maximum) and then discharged (by spark-gap switches) through turned inductances to obtain a relatively square waveform.

A PFN consisting of two stages (the main energy storage stage and a pulse shaping stage) was evaluated in this study. Each stage generates a different harmonic of the desired waveshape. When the outputs of both stages are added together at the load, the resultant waveform has the desired shape and amplitude. This paper focuses on the design and operation of the high-voltage module and a pulser which was developed using two of the modules in series. Design philosophy, module fabrication, and operational results will be presented. Each component of the pulser is discussed. 3 refs., 6 figs.

34213 (SAND–88-3486) **Video image analysis using the Selective Video Processor development platform.** Bandat, N.E. Sandia National Labs., Albuquerque, NM (USA). Aug 1989. 91p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. Order Number DE89012248/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

The intent of the Selective Video Processor (SVP) project is to develop a flexible system which can interpret a video image by analyzing the color or gray scale variations between image sequences. The concepts on which the SVP system are based have potential applications in a variety of areas including motion detection, battlefield surveillance, road following, edge detection, and object detection. A prototype development platform has been completed which includes a SVP hardware module, and a graphics user interface module. The SVP platform enables a variety of applications to be developed and tested in a high level environment. Once an application has been perfected on the development platform, specialized hardware and software can be implemented to create a fieldable version of the application. Fieldable units are expected to have the advantages of small space requirements, low costs, low power dissipations, and real time operating speeds. An intrusion detection application has been developed on the platform to demonstrate the usefulness of the SVP system. This report describes the prototype development platform, the intrusion detection application and future directions for the SVP project. 18 refs., 18 figs., 3 tab.

34214 (SAND–89-0048C) **A study of compact, lightweight, high voltage inductors with partial magnetic cores.** Lawson, R.N.; Rohwein, G.J. Sandia National Labs., Albuquerque, NM (USA). 1989. 9p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890665–11: 7. Institute of Electrical and Electronics Engineers pulsed power conference, Monterey, California, USA, 12-14 Jun 1989). Order Number DE89013152/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

On occasions where the inductance of high voltage coils must be raised by utilizing ferromagnetic cores, it has been found that partial cores comprised of symmetrical arrangements of ferrite bars are more efficient in terms of inductance gain per weight of material than either full-flux path cores or solid-slug type cores. Proper placement of the core material, however, is essential to achieving maximum inductance gain. This paper will describe a series of experiments that were conducted to determine the optimum arrangement of distributed bar-type partial cores. Data from the various experiments will be presented. 1 ref., 4 figs.

34215 (SAND–89-0181C) **Total-dose hardness assurance for space applications of commercial CMOS devices.** Fleetwood, D.M.; Winokur, P.S.; Pease, R.L. Sandia National Labs., Albuquerque, NM (USA). 1989. 5p. Sponsored by DOE/DP;OGA. DOE Contract AC04-76DP00789. (CONF-890723–2: 26. annual conference on nuclear and space radiation effects, Marco Island, Florida, USA, 24-28 Jul 1989). Order Number DE89006765/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Lot acceptance tests are evaluated for nonhardened CMOS devices for low total-dose space applications. Examples are presented for cases in which gate- or field-oxide leakage dominates device response. 12 refs., 3 figs.

34216 (SAND–89-0218C) **Dual-transistor method to determine ΔV_{ot} and ΔV_{it} for MOS devices.** Fleetwood, D.M.; Schwank, J.R.; Sexton, F.W. Sandia National Labs., Albuquerque, NM (USA). 1989. 5p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890723–1: 26. annual conference on nuclear and space radiation effects, Marco Island, Florida, USA, 24-28 Jul 1989). Order Number DE89006725/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

It is shown how standard ΔVth and mobility measurements made on otherwise identical n- and p-channel transistors can be combined to accurately estimate radiation-induced ΔV_{ot} and ΔV_{it}. Applications of the method are described. 12 refs., 2 figs.

34217 (UCID–21729) **Electronics Engineering publication report: Calendar year 1988.** Lawrence Livermore National Lab., CA (USA). Apr 1989. 58p. Sponsored by DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE89013382/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

This document represents the first annual report published by Electronics Engineering (EE) listing all formal publications during the calendar year. The listing is alphabetized by first author. Anyone desiring a copy of a listed report should contact the author(s). The entries in this report represent contributions from all Electronic Engineering divisions and were compiled, edited, and keyboard by Marian Holten, Elaine Globig, June Cramer, and the EE Word Processing Center.

34218 Wavelength scaling of BRDF scatter data. Stover, J.C. (Lawrence Livermore Nat. Lab., Livermore, CA (US)); Gillespie, C.H.; Cady, F.M.; Cheever, D.R.; Klicker, K.A. v.v of Current developments in optical engineering II. Fischer, R.E.; Smith, W.J. SPIE Society of Photo-Optical Instrumentation Engineers, Bellingham, WA (1987). (CONF-8708232–: Current developments in optical engineering II, San Diego, California, USA, 18-21 Aug 1987).

Light scattered by optical components is becoming an increasingly troublesome problem in many modern optical designs. Serious attention is now being paid to this issue by several government and industry labs who are using, or are planning to use, scatter measurements as acceptance criteria for optical components. One of the difficulties associated with scatter measurements is the large number of variables that can vary the scatter distribution. In addition to sample parameters, such as roughness, bulk defects and contamination, there are sample independent parameters such as polarization, angle of incidence and wavelength. Separating the various effects is not trivial; although, there can be strong economic motivations to do so. The usual approach has been to make scatter measurements under the conditions expected for actual use–that is, to use the polarization, incident angle and wavelength that are intended for eventual use to make the scatter measurements. Polarization and incident angle are relatively easy to adjust in most instruments, but generating different wavelength capabilities is more expensive. In addition, the variable of incident angle has already been examined for the case of reflective optics. This paper examines the possibility that scatter measurements made at one wavelength can be used through a process commonly referred to as wavelength scaling to predict scatter at other wavelengths.

34219 Comparison of BRDF data from two scatterometers. Stover, J.C. (Lawrence Livermore Lab., Livermore, CA (US)); Gillespie, C.H.; Cady, F.M.; Cheever, D.R.; Klicker, K.A. v.v of Current developments in optical engineering II. Fischer, R.E.; Smith, W.J. SPIE Society of Photo-Optical Instrumentation Engineers, Bellingham, WA (1987). (CONF-8708232–: Current developments in optical engineering II, San Diego, California, USA, 18-21 Aug 1987).

In the early 1970's one of the ASTM study groups ran a series of round robin measurements to determine the validity of comparing (TIS) measurements from one lab to another. Initial results were very discouraging. TIS values varied over orders of magnitude between labs and measurements were difficult to repeat from one round to the next at the same lab. Slowly, experience was gained in reducing operator error, limiting contamination problems and recognizing basic differences between the instruments under use. The importance of surface spatial frequency bandwidths was recognized and comparison results showed some improvement. In the mid-seventies, measurement of scatter, as a function of angle from specular, was used to obtain more information about surface finish. The scatter research of the 1970's is now being combined with the computers of the 1980's to produce fast, accurate scatter inspection systems to help meet the increased demands for low scatter optics. Although most of these systems produce the bidirectional scatter (reflectance, transmission) distribution function (BSDF, BRDF, BTDF), some are capable of producing surface statistics as well. The BRDF can be used to calculate a surface power spectral density (PSD) function, which in turn provides values of root mean

square roughness and a transverse length parameter. The question of how these instruments relate to the surface statistics produced by surface profiling instruments is now being studied.

34220 Extrinsic gettering for VLSI/ULSI processes. Medernach, J.W. (Sandia National Labs., Albuquerque, NM (US)); Witherspoon, L.L. v.v of Proceedings of the 1987 Electrochemical Society spring meeting: Extended abstracts. Volume 87-1. The Electrochemical Society, Pennington, NJ (1987). (CONF-870560–: 171. Electrochemical Society meeting, Philadelphia, Pennsylvania, USA, 10-15 May 1987).

Gettering techniques are employed to reduce metallic impurities that can be accumulated during device processing. The removal of these metallic impurities from active device regions improved device yield, oxide integrity, and other device parameters. Intrinsic (IG) and extrinsic (EG) gettering techniques are reported to be effective, but may not be as effective for small geometry processing because of possible problems regarding reproducibility and uniformity of oxygen precipitation phenomena. The object of our investigation was to develop if possible, an EG technique in which a uniform internal defect formation is formed for a n/n+ epitaxial structure. The use of medium and high oxygen content n+ substrates with and without poly/nitride Eg layers for a 2.0μm to 1.0μm p-well CMOS process is reported. This study employed n/n+ epitaxial silicon on '00mm diameter silicon wafers with a (100) orientation. Specific n+ substrate parameters were previously reported. The epitaxial layer was n-type phosphorus doped with a resistivity of 1.25 ohm-Ω and thickness of 5.0μm. Extrinsic gettering layers of polysilicon/nitride [PN] were applied as a post-epi process with a thickness of 2.0μm and 0.045//n/m, respectively.

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Refer also to citation(s) 33354

34221 (SNV–3481) **Waste handling and utilization in an international perspective.** Holmberg, N. National Swedish Environmental Protection Board, Solna (Sweden). May 1988. 72p. (In Swedish). Order Number DE89776228/JAW. Available from NTIS (US Sales Only), PC A04/MF A01;1.

The report is part of the evaluation of the technical and economical bases for an increased re-use of waste. Main headings: * General information. * Sorting of domestic waste at the source. * Vehicles. * Composting of green waste. * Fermentation of organic waste. * Central sorting. * Combustion, gasification. * Depositing. * Improving of building waste * Improving of plastic waste. * Waste harmful to environment. * Waste exchange. * Various. * Information. * Environment aware enterprising. (O.S.).

34222 (SNV–3486) **Markets for recovered materials.** Henriksson, G. National Swedish Environmental Protection Board, Solna (Sweden). May 1988. 79p. (In Swedish). Order Number DE89776229/JAW. Available from NTIS (US Sales Only), PC A05/MF A01;1.

The purpose of the investigation is to identify and describe existing and potential markets for various kinds of materials and to analyze quality demands, threats and prospects concerning existing recovery systems and bases for establishing new ones. (O.S.).

4210 Combustion Systems

Refer also to citation(s) 33144, 34099, 34111, 34428

34223 (STEV-FBT–89-16) **Staged air supply for NO_x reduction in FBC.** Leckner, B. Statens Energiverk, Stockholm (Sweden). 1987. 14p. (CONF-8710472–: IAE AFBC technical meeting, Tokyo, Japan, Oct 1987). Order Number DE89776266/JAW. Available from NTIS (US Sales Only), PC A03/MF A01;1.

The air for fluidization and combustion is normally supplied through the air distributor which forms the bottom of the combustion chamber of a fluidized bed boiler. It is possible to by-pass some of the air outside of the lower part of the combustion chamber and injection it at a certain height above the bottom in the form of secondary air. To create a zone with lower average oxygen concentration and consequently, an increased char surface and CO concentration for NO reduction. In addition there is an increased escape of volatile nitrogen- containing compounds, such as ammonia, from the oxygen-starved zone. The ammonia may subsequently contribute to the reduction of NO in the freeboard. Make-up air for the completion of combustion, the secondary air, is added above this oxygen-starved zone. The following preliminary conclusions can be formulated: - The nitrogen oxide emission is influenced by the effective air ratio of the bed. - Secondary air addition in itself has no importance for the nitrogen oxide emission if the injection nozzles are situated sufficiently far from the bed. Secondary air addition does have an importance for the completion of combustion, specially of the gases. Recirculated flue gases would probably have the same effect as secondary air (or even better) provided there is some excess air in the bed. - Secondary air addition may have a negative influence on the nitrogen oxide emission of the air nozzles are situated too close to the bed, specially at low bed air ratios. - Circulating beds with an inert bed material (sand) are much less dependent on the air ratio than stationary beds. - The difference between stationary and circulating beds with respect to the influence of the air ratio on nitrogen oxide emissions is probably due to the conversion of volatile nitrogen to nitrogen oxide in and above the dense bed.

4230 Marine Engineering

Refer also to citation(s) 33163, 33891

34224 (AUC-IBT-R–8828) **Stochastic fatique analysis of jacket type offshore structures.** Structural Reliability Theory. Paper, 50. Sigurdsson, G. Aalborg Universitetscenter (Denmark). Inst. for Bygningsteknik. Sep 1988. 23p. (CONF-8809356–: 2. IFIP WG 7.5 working conference on reliability and optimization of structural systems, London, UK, 26-28 Sep 1988). Order Number DE89776123/JAW. Available from NTIS (US Sales Only), PC A03/MF A01;1.

Structural Reliability Theory. Paper, 50.

In this paper a stochastic reliability assessment for jacket type offshore structures subjected to wave loads in deep water environments is outlined. In the realiability assessment, structural and loading uncertainties are taken into account by means of some stochastic variables. To estimate statistical measures of structural stress variations the model spectral analysis method is applied. The analysis is divided into four steps: a description of the sea state, (including a short-term and a long-term model), a description of the wave loading, a structural analysis and a fatigue analysis. A method to estimate the reliability of offshore structures subjected to wave loads in deep water environments is presented. Failure modes corresponding to fatigue failure are used. The reliability is estimated using a first-order reliability method. The statistically measured of structural stress variations is estimated by using model spectral analysis method. The damage in the failure elements is estimated by using Miner's rule and S-N approach. The distribution function of the stress amplitudes, for a given sea state, is estimated by Rayleigh distribution, Rice distribution, RFC-method and RC-method. For most of the sea states under consideration the stress process became broad-banded and therefore, the results by using Rayleigh distribution cannot be expected to give satisfactory results. The RFC and RC methods give a different estimation of the distribution function of the stress amplitudes, resulting in a major difference in the estimate of the safety indices. This means that the order and definition of the stress amplitudes must be taken into account in the damage accumulation model. For this purpose more experimental and theoretical work are needed. (AB) 16 refs.

4240 Pollution Control Equipment

Refer also to citation(s) 33443, 33444

43 PARTICLE ACCELERATORS

Refer also to citation(s) 34945

34225 (GANIL-A–88-06) **Present and future development at Ganil.** Ferme, J. Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France). 1988. 12p. Order Number

DE89781490/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

GANIL has been in operation since January 1983. During this period beams from Carbon to Xenon have been available continuously for physics. There is now a demand to extend the ion range up to uranium, and to increase the beam intensity above the present level of about 3 microamperes with light ions. The corresponding modifications of the machine have been studied and will be made in the near future. Progress in ion sources, beam diagnostics, computer control is reported. Speculative considerations on the distant future are discussed.

34226 (KIYI–88-2, pp. 16-25) **Technical equipment in medico-biological complex of Kiev U-120 cyclotron.** Grantsev, V.I.; Gul'ko, G.M.; Isaenko, V.I.; Koval', G.N.; Linev, A.F.; Nikishin, B.K.; Produvalov, Yu.S.; Svarichevskaya, E.V. AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij. 1988. (In Russian). In *Medico-biological complex of Kiev cyclotron U-120 (MBC U-120).* Order Number DE89780086/JAW. Available from NTIS (US Sales Only), PC A03/MF A01; INIS.

Medico-biological complex on the basis of the U-120 cyclotron designed for radiobiological researches and neutron therapy is described. Beryllium target ensuring complete absorption of incident deuterons with the energy of 13.6 MeV is used as a neutron source. The flowsheet of charged particle transport in the U-120 accelerators is given. 8 refs.; 4 figs.

34227 (SAND–89-0071C) **Hermes-III positive polarity experiment.** Johnson, D.L.; Alexander, J.A.; Ramirez, J.J.; Corley, J.P.; Denison, G.J.; Poukey, J.W.; Lockner, T.R.; Rosenthal, S.E.; Ruiz, C. Sandia National Labs., Albuquerque, NM (USA). 1989. 19p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890665–12: 7. Institute of Electrical and Electronics Engineers pulsed power conference, Monterey, California, USA, 12-14 Jun 1989). Order Number DE89013153/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Hermes-III is a 22-MV, 730-kA, 40-ns electron beam linear induction accelerator with a magnetically insulated transmission line (MITL) adder used to produce bremsstrahlung radiation. Hermes-III has been operated in a reverse polarity mode to study possible applications of the Hermes-III technology to Sandia National Laboratories' Inertial Confinement Fusion Program. To accomplish the polarity reversal, the twenty induction cavities were rotated and the MITL was reinserted in the cavities. The Marx generators and the pulse forming networks were operated in negative polarity as before. The accelerator was operated at three levels: 50%, 80%, and 95% of full voltage and with two diode configurations. Data is presented on the operation of the positive polarity MITL adder, on the effects on the cavities, and on the operation of a pinched-beam, ion diode. 9 refs., 8 figs., 1 tab.

4301 Design, Development, and Operation

Refer also to citation(s) 34255, 35457, 35459, 35460, 35461, 35463

34228 (DOE/FTR–9012955) **[Exchange of information on computing and communication services with peer European research laboratories, Saclay and Lyon, France, Chilton, United Kingdom, May 23–June 2, 1989]: Foreign trip report.** Peskin, A.M. Brookhaven National Lab., Upton, NY (USA). 9 Jun 1989. 51p. Sponsored by DOE Energy Research. DOE Contract AC02-76CH00016. Order Number DE89012955/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

This trip was intended to afford an opportunity to exchange information on scientific computing and communication services with appropriate individuals at selected European peer research institutions. A second purpose was to assess the viability of the HEPVM collaboration for providing a common IBM VM operating system at the major high energy physics laboratories. This assessment is crucial, as Brookhaven is considering joining that collaboration, and has in fact already taken steps toward that end. The three laboratories chosen to be visited, SACLAY, IN2P3, and Rutherford, are three of the five major partners in that collaboration. The timing for the visit was chosen to coincide with the T89 International Telecommunications Exhibition and Conference to have been held in Paris, but that conference was cancelled by the organizers due to a scheduling conflict. As a result of the meetings with my counterparts at Saclay, IN2P3, and RAL, a great deal of useful information was exchanged which should prove valuable toward shaping our future strategic directions. I also concluded that the management commitment to the HEPVM collaboration is high and Brookhaven will find affiliation with it to be beneficial. The next HEPVM meeting is scheduled to be held at Brookhaven in August, 1989.

34229 (INIS-mf–11456, pp. 75-80) **Czechoslovak project of synchrotron radiation source.** Hrdy, J. (Ceskoslovenska Akademie Ved, Prague (Czechoslovakia). Fyzikalni Ustav). Jednota Ceskoslovenskych Matematiku a Fyziku, Prague (Czechoslovakia). 1987. (In Czech). (CONF-8707217–: 9. conference of Czechoslovak physicists, Pardubice, Czechoslovakia, 6-10 Jul 1987). In *Ninth conference of Czechoslovak physicists. Part 1, 2.* Order Number DE89617602/JAW. Available from NTIS (US Sales Only), PC A22/MF A01 - OSTI; INIS.

The principle is described of synchrotron radiation and the basic notions given of the physics of the storage ring. Special devices are described inserted in the direct sections of the ring, such as undulators and wigglers which cause the undulation of the trajectory of particles. The said particles then become the source of radiation. Suggested parameters are given for the Czechoslovak project of the source of synchrotron radiation. (J.B.).

34230 (JINR–9-88-396) **Dubna synchrophasotron. Operation and improvement. (Quarters 3 and 4, 1987).** Balandikov, A.N.; Belushkina, A.A.; Buldakovskij, V.N. and others. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy. 1988. 11p. (In Russian). Order Number DE89620105/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Information on the operation of the accelerator in the second hals of 1987 and during the year is presented. Further works on polarized deuteron source were continued in order to improve control for its parameters and to expand its possibilities. In the region of target station of the first slow extraction two detectors were installed to obtain a full picture about characteristics of the extracted beam. The data go to the central console and is processed by SM-4 computer. To facilitate the tuning and to increase the stability of second slow extraction parameters the apparatus has been put into operation and software has been created. Information on the results of geodetic measurements of position of synchrophasotron electromagnet is given. 5 refs.; 2 figs.; 5 tabs.

34231 (LBL–27174) **A unified approach to building accelerator simulation software for the SSC.** Paxson, V.; Aragon, C.; Peggs, S.; Saltmarsh, C.; Schachinger, L. Lawrence Berkeley Lab., CA (USA). Mar 1989. 3p. Sponsored by DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-890335–191: 13. particle accelerator conference, Chicago, Illinois, USA, 20-23 Mar 1989). Order Number DE89013693/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

To adequately simulate the physics and control of a complex accelerator requires a substantial number of programs which must present a uniform interface to both the user and the internal representation of the accelerator. If these programs are to be truly modular, so that their use can be orchestrated as needed, the specification of both their graphical and data interfaces must be carefully designed. We describe the state of such SSC simulation software, with emphasis on addressing these uniform interface needs by using a standardized data set format and object-oriented approaches to graphics and modeling. 12 refs.

34232 (SAND–89-0080C) **Positive polarity voltage adder MITL [magnetically insulated transmission line] experiments on HELIA.** Corley, J.P.; Heath, C.E.; Johnson, D.L.; Rosenthal, S.E.; Poukey, J.W.; Ramirez, J.J.; Smith, I.D.; Spence, P.W.; Fockler, J.J. Sandia National Labs., Albuquerque, NM (USA). 1989. 19p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890665–16: 7. Institute of Electrical and Electronics Engineers pulsed power conference, Monterey, California, USA, 12-14 Jun 1989). Order Number DE89014705/JAW. Available from NTIS, PC A - OSTI; GPO Dep.

HELIA is a four stage, 4-MV, 250-kA, 30-ns accelerator used to study the design concepts for Hermes III. The accelerator consists

of eight pulse forming lines (PFLs) that deliver 1-MV, 125-kA pulses to four linear induction cavities. The cavities are in series, and the voltage addition is accomplished in a coaxial self magnetically insulated transmission line (MITL). A positive polarity experiment has been performed on Hermes III that shows efficient current transport through the system. HELIA has been reconfigured for positive polarity operation, and initial experimental results show operation consistent with Hermes III results. These experiments are aimed at obtaining a more complete understanding of the system performance in positive polarity and to investigate the interactions of the cavities, adder MITL, and extensions in this configuration. Initial results and details of these tests are presented in this paper. 8 refs., 9 figs., 1 tab.

34233 (SLAC–334) **Linear Collider Working Group reports from Snowmass '88.** Ruth, R.D. (ed.). Stanford Linear Accelerator Center, Menlo Park, CA (USA). Mar 1989. 90p. Sponsored by DOE Energy Research. DOE Contract AC03-76SF00515. (CONF-8806243–Exc.: DPF summer study: Snowmass '88: high energy physics in the 1990s, Snowmass, Colorado, USA, 27 Jun - 15 jul 1988). Order Number DE89013387/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

This report contains a summary of the Linear Collider Working Group. Papers on the following topics are discussed: parameters; damping ring; bunch compressor; linac; final focus; and multibunch effects.

34234 (SLAC-PUB–4868) **Summary of the Linear Collider Working Group.** Ruth, R.D. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Jan 1989. 8p. Sponsored by DOE Energy Research. DOE Contract AC03-76SF00515. (CONF-8806243–42: DPF summer study: Snowmass '88: high energy physics in the 1990s, Snowmass, Colorado, USA, 27 Jun - 15 jul 1988). Order Number DE89013748/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The focus of the Linear Collider Working Group was on a next generation linear collider. Topics discussed are: parameters; damping rings; bunch compression and pre-acceleration; linac; final focus; and multibunch effects. 8 refs., 3 figs., 7 tabs.

34235 (SLAC-PUB–4936) **Distributed Supervisory Protection Interlock System.** Walz, H.V.; Agostini, R.C.; Barker, L.; Cherkassky, R.; Constant, T.; Matheson, R. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Mar 1989. 3p. Sponsored by DOE Energy Research. DOE Contract AC03-76SF00515. (CONF-890335–206: 13. particle accelerator conference, Chicago, Illinois, USA, 20-23 Mar 1989). Order Number DE89013754/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The Distributed Supervisory Protection Interlock System, DSPI, is under development at the Stanford Linear Accelerator Center for requirements in the areas of personnel protection, beam containment and equipment protection interlocks. The DSPI system, distributed over the application site, consists of segments with microprocessor-based controller and I/O modules, local area networks for communication, and a global supervisor computer. Segments are implemented with commercially available controller and I/O modules arranged in local interlock clusters, and associated software. Segments provide local interlock data acquisition, processing and control. Local area networks provide the communication backbone between segments and a global supervisor processor. The supervisor processor monitors the overall system, reports detail status and provides human interfaces. Details of an R and D test system, which will implement the requirements for personnel protection of 4 typical linear accelerator sectors, will be described. 4 refs., 2 figs.

34236 **RF system considerations for a large hadron collider.** Raka, E. (Brookhaven National Laboratory, Upton, NY 11973(US)). *AIP (American Institute of Physics) Conference Proceedings (USA),* 184(1): 288-342 (1 Apr 1989). (CONF-8707208–: U.S. Particle Accelerator School: physics of particle accelerators, Batavia, Illinois, USA, 20 Jul - 14 aug 1987).

The radio-frequency (rf) system of a large hadron collider is require to operate in three different modes. It must capture and accumulate in stationary buckets (closed trajectories in longitudinal phase space) successive groups of bunches from its injector; accelerate these bunches in moving buckets up to the design energy; and finally store them, for several hours, while maintaining a minimum ratio of bunch-to-bucket area. In the storage mode it provides the nominal energy gain per turn required to make up for synchrotron radiation losses and for the power loss due to voltages induced in the impedances presented to the beam by the vacuum chamber and accelerating structures. In what follows then, we shall discuss how we arrive at a particular choice of voltage and frequency; the type of accelerating structure that would be suitable for obtaining the required voltage and resonant impedance; static beam loading including a simplified beam stability criterion involving the beam current and total rf system shunt impedance; the basic principle of rf phase and frequency control loops; and the effect of rf noise and its interaction with these loops. Finally, we shall consider the need for and design of rf systems to damp independently coherent oscillations of individual bunches or groups of bunches. (AIP)

4302 Beam Dynamics, Field Calculations, and Ion Optics

Refer also to citation(s) 34141, 34151, 34234, 34303, 34316, 35462

34237 (ANL-HEP-PR–89-45) **Experimental measurement of nonlinear plasma wake-fields.** Rosenzweig, J.B.; Schoessow, P.; Cole, B.; Gai, W.; Konecny, R.; Norem, J.; Simpson, J. Argonne National Lab., IL (USA). High Energy Physics Div. 1989. 3p. Sponsored by DOE Energy Research. DOE Contract W-31109-ENG-38. (CONF-890335–210: 13. particle accelerator conference, Chicago, Illinois, USA, 20-23 Mar 1989). Order Number DE89014636/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We report direct high resolution observation of nonlinear steepened plasma waves excited in the wake of an intense, self-pinched electron beam. Oscillators in both accelerating and deflecting fields are measured, and analyzed in the context of linear and nonlinear plasma wave theory. The degree of nonlinearity in the wake-fields is shown to be consistent with analytical predictions of the beam self-pinching. The impact of these results on plasma acceleration and focusing schemes is discussed. 15 refs., 4 figs.

34238 (BNL–41897) **Measurement of the magnetic field coefficients of particle accelerator magnets.** Herrera, J.; Ganetis, G.; Hogue, R.; Rogers, E.; Wanderer, P.; Willen, E. Brookhaven National Lab., Upton, NY (USA). 1989. 4p. Sponsored by DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-890335–198: 13. particle accelerator conference, Chicago, Illinois, USA, 20-23 Mar 1989). Order Number DE89014710/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

An important aspect in the development of magnets to be used in particle accelerators is the measurement of the magnetic field in the beam aperture. In general it is necessary to measure the harmonic multipoles in the dipole, quadrupole, and sextupole magnets for a series of stationary currents (plateaus). This is the case for the Superconducting Super Collider (SSC) which will be ramped to high field over a long period (~1000 sec.) and then remain on the flat top for the duration of the particle collision phase. In contrast to this mode of operation, the Booster ring being constructed for the Brookhaven AGS, will have a fast ramp rate of approximately 10 Hz. The multipole fields for these Booster magnets must therefore be determined "on the ramp." In this way the effect of eddy currents will be taken into account. The measurement system which we will describe in this paper is an outgrowth of that used for the SSC dipoles. It has the capability of measuring the field multipoles on both a plateau or during a fast ramp. In addition, the same basic coil assembly is used to obtain the magnetic multipoles in dipole, quadrupole, and sextupole magnets. 2 refs., 3 figs., 1 tab.

34239 (CONF-890335–200) **Analysis of rf modes in the ANL APS vacuum chamber using computer simulation, electron beam excitation, and perturbation techniques.** Kustom, R.; Bridges, J.; Chou, W.; Cook, J.; Mavrogenes, G.; Nicholls, G. Argonne National Lab., IL (USA). 1989. 3p. Sponsored by DOE Energy Research. DOE Contract W-31109-ENG-38. From 13. particle accelerator conference; Chicago, Illinois, USA; 20-23 Mar 1989. Order Number DE89014675/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The APS vacuum consists of a nearly elliptical beam chamber coupled to an antechamber through a 1-cm-high, 10-cm-long pumping slot over most of the 1104 m of storage ring circumference. Nonevaporable getter (NeG) strips in the antechamber are the pumping element. The 1-cm-high slot has two functions: to provide good conductance for vacuum pumping and for transmission of the photons into the beam ports. We thought that coupling of the beam to the antechamber might occur through the slot. Since the beam fields are transverse magnetic to the beam (TM_z), no coupling occurs below the TM cutoff of the slot (15 GHz for 1 cm) because no wall currents are interrupted. Also, the frequency spectrum of a rigid bunch is well below 15 GHz. Both computer calculations and measurements were done to verify that no coupling occurs. Computer calculations in the frequency domain and two-arm wire measurements with picosecond pulses were previously reported. The wire measurements confirmed that little coupling occurs between the two chambers. In addition to those earlier studies, a real-time MAFIA-T3 study in 3D was done, and a measurement of modes excited by a 38-ps, 20-MeV electron beam has been completed. These results are the primary topic of this paper. Some measurements made with a network analyzer and bead perturbation equipment will also be discussed. 8 refs., 11 figs.

34240 (FNAL-TM–1590) **Linear analysis of the momentum cooling Fokker-Planck equation.** Rosenzweig, J.B. Fermi National Accelerator Lab., Batavia, IL (USA). 4 May 1989. 12p. Sponsored by DOE Energy Research. DOE Contract AC02-76CH03000. Order Number DE89013724/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

In order to optimize the extraction scheme used to take antiprotons out of the accumulator, it is necessary to understand the basic processes involved. At present, six antiproton bunches per Tevatron store are removed sequentially by RF unstacking from the accumulator. The phase space dynamics of this process, with its accompanying phase displacement deceleration and phase space dilution of portions of the stack, can be modelled by numerical solution of the longitudinal equations of motion for a large number of particles. We have employed the tracking code ESME for this purpose. In between RF extractions, however, the stochastic cooling system is turned on for a short time, and we must take into account the effect of momentum stochastic cooling on the antiproton energy spectrum. This process is described by the Fokker-Planck equation, which models the evolution of the antiproton stack energy distribution by accounting for the cooling through an applied coherent drag force and the competing heating of the stack due to diffusion, which can arise from intra-beam scattering, amplifier noise and coherent (Schottky) effects. In this note we examine the aspects of the Fokker-Planck in the regime where the nonlinear terms due to Schottky effects are small. This discussion ultimately leads to solution of the equation in terms of an orthonormal set of functions which are closely related to the quantum simple-harmonic oscillator wave-functions. 5 refs.

34241 (GANIL-A–88-01) **Galopr, a beam transport program, with space-charge and bunching.** Bru, B. Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France). 1988. 3p. Order Number DE89781548/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

GALOPR is a first order beam transport code including three dimensional space -charge forces and the beam bunching process. It deals with usual optical devices (bending magnets, lenses, solenoids, drifts, bunchers) and can take into account any special optical device represented by its transfer matrix with space-charge the ('Muller inflector' was recently introduced as one of these devices). The beam can be continuous or undergoing a bunching or debunching process. The beam line parameters can be optimized in order to fit at will the 6 x 6 transfer matrix and the 6 x 6 covariance matrix for a maximum beam intensity. The results are presented with useful data tables and graphical displays.

34242 (IYaF–88-94) **Evolution of ion momentum distribution function in electrohydrodynamic emission.** Dudnikov, V.G.; Shabalin, A.L. AN SSSR, Novosibirsk (USSR). Inst. Yadernoj Fiziki. 1988. 17p. (In Russian). Order Number DE89620117/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The evolution of ion momentum distribution function due to interbeam interaction is considered. The specificity of electrohydrodynamic emission is taken into account. The broadening of the ion momentum distribution function resulted is growing the energy spread and emitter virtual size is caused by stochastic fields connected with nonordered disposition of ions. A little amount of potential energy of interacting ions is converted into kinetic energy of chaotic motion. The main energy broadening takes place at a distance of 10^{-6} cm from the emitter and an increase of the source virtual size occurs at a beam drift in the ion beam system. 20 refs.; 5 figs.

34243 (JAERI-M–88-149, pp. 2-21) **Free electron laser and accelerator.** Sato, Isamu (National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan)). Japan Atomic Energy Research Inst., Tokyo (Japan). Aug 1988. (In Japanese). (CONF-8803200–: 1. workshop on the free electron laser, Tokai, Japan, 1 Mar 1988). In *Proceedings of the free electron laser workshop, 1988 JAERI.* Order Number DE89780071/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

The present report addresses several aspects of the free electron laser (FEL) and accelerator, including their features, potentials, mechanisms, beams emitted from undulator, FEL produced by helical mangnetic field, major problems with FEL, etc. In FEL, relativistic electron beams interact with an electromagnetic field with periodically changing intensity to produce coherent electromagnetic waves with variable wavelength. The capability of varying its wavelength represents the greatest advantage over conventional lasers. Any periodic magnetic field can serve as a wiggler. A wiggler can be used both in an amplifier and oscillator. A periodic magnetic field used may be either of a parallel type or of a helical type. The polarization of emitted beams depends on the shape of the magnet regardless of whether its field is parallel or helical. An equation is derived in the report which expresses the wavelength of an electromagnetic wave produced by an undulator. An analysis is made of FEL produced by a helical magnetic field, focusing on the interaction of free electrons with an electromagnetic wave, energy exchange, theoretical consideration of the amplifier gain, and limitations on FEL. The report also addresses some problems related with linear electron accelerators, electron storage rings, etc. (N.K.).

34244 (JAERI-M–88-155) **Beam optics of a superconducting booster for the JAERI tandem accelerator.** Tomita, Yoshiaki; Ishii, Tetsuro; Takeuchi, Suehiro; Kikuchi, Shiro; Minehara, Eisuke. Japan Atomic Energy Research Inst., Tokyo (Japan). Aug 1988. 70p. (In Japanese). Order Number DE89778012/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

In order to investigate beam optics of a superconducting booster for the JAERI tandem accelerator, a computer program has been written which calculates beam trajectories in the booster. By using this program various configurations have been examined and a configuration has been chosen as a 'good' candidate. Calculation has been made for ^{12}C, ^{35}Cl and ^{127}I beams and it has been shown that 50-60% of continuous beam can be accelerated even without a prebuncher, if intended control of the beam can be accomplished. Some discussion is given on problems in contro-ling the beam.

34245 (JINR-R–9-88-424) **Investigation of ion influence on electron ring stability during its compression in the KUTI-20 adhezator.** Aleksakhin, Yu.I.; Antropov, V.K.; Mal'tsev, A.A. and others. Joint Inst. for Nuclear Research, Dubna (USSR). 1988. 13p. (In Russian). Order Number DE89620121/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Crossing of parametric resonance of axial oscillations is experimentally investigated as well as excitation of the adhezator metal vacuum chamber as a resonant cavity at the first azimuthally asymmetric eigenmode. The increase in the ring intensity is shown to reduce particle losses in parametric resonance if it is crossed with the magnetic field index decreasing and to supress the resonance instability of the chamber eigenfrequency. The discovered effects are related to the influence of ions stored in the electron ring. The electron axial oscillation frequency shift due to the ion focusing is determined from the measured variation in the field index resonant value and in the angular distribution of synchrotron radiation. 20 refs.; 13 figs.

34246 (LBL–25955) **Impedance measurements on button electrodes.** Jacob, A.; Lambertson, G.R. Lawrence Berkeley Lab., CA (USA). Mar 1989. 3p. Sponsored by DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-890335–193: 13. particle accelerator conference, Chicago, Illinois, USA, 20-23 Mar 1989). Order Number DE89013686/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

In the Advanced Light Source, there will be about 400 capacitance button electrodes in the beam position monitor (BPM) system, hence the contribution of each button to the machine beam impedance must be very small. We have measured the impedance of a single button as sensed by a coax connected directly to the button surface. This method is very sensitive and did not require a model of the total beam chamber as would the usual wire method. The measurements covered the range 0.1–20 GHz. The proportionality factor between the button impedance and the beam impedance depends upon geometry and frequency and was obtained from the measured sensitivity of a developmental BPM at low frequency. Discontinuities in the connection of the coax to the face of the button introduce parasitic effects that must be accounted for in interpreting the data. Below 5 GHz the results compare very well with responses computed from mechanical dimensions of the electrode. Above 15 GHz corrections for the parasitic elements become more uncertain, but the accuracy of the method is still adequate. The results show multiple resonances, a prominent example being for one button a beam impedance peak of ~1 ohm with a Q of 500 at 16 GHz. 2 refs., 7 figs.

34247 (LBL–25958) **The effects of insertion devices on beam dynamics in the ALS [Advanced Light Source].** Jackson, A.; Forest, E.; Nishimura, H.; Zisman, M.S. Lawrence Berkeley Lab., CA (USA). Mar 1989. 3p. Sponsored by DOE Energy Research. DOE Contract AC03-76SF00098. (ESG–60;CONF-890335–192: 13. particle accelerator conference, Chicago, Illinois, USA, 20-23 Mar 1989). Order Number DE89013692/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Third generation synchrotron radiation sources, such as the Advanced Light Source (ALS), are specifically designed to operate with long undulators that produce very high brightness beams of synchrotron radiation. Including such devices in the storage ring magnet lattice introduced extra linear and nonlinear fields that are intrinsic to the undulator. These fields break the symmetry of the lattice and provide driving forces for nonlinear resonances, thereby perturbing the dynamics of the electron motion, particularly at large amplitudes. The main impact of these perturbations is on the beam lifetime, arising out of a reduction of both the transverse acceptance and the momentum acceptance. In this paper, we present the results of an ongoing study of these effects as they relate to the performance of the ALS. 7 refs., 7 figs., 2 tabs.

34248 (LBL–25983) **Influence of the synchrotron radiation on particle dynamics in a rectangular undulator.** Chin, Yong Ho. Lawrence Berkeley Lab., CA (USA). Mar 1989. 3p. Sponsored by DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-890335–189: 13. particle accelerator conference, Chicago, Illinois, USA, 20-23 Mar 1989). Order Number DE89013000/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This paper is concerned with the synchrotron radiation from an undulating electron beam in a rectangular waveguide. It is shown analytically and numerically that the radiated energy spectrum may differ significantly from the free space result when the undulator length divided by the Lorentz factor of the electron beam is larger than the transverse size of the waveguide. The undulator radiation is identified with the awake field in beam instabilities. The concepts of wake function and impedance are introduced to formulate the present problem in the same manner as the beam instability problem. It is shown that the obtained impedances satisfy the Panofsky-Wenzel theorem and other properties inevitable for wake fields. 5 refs., 2 figs.

34249 (NAC–88-03) **Method for the stress calibration of a beam buncher.** Conradie, J.L.; Botha, A.H. Council for Scientific and Industrial Research, Faure (South Africa). National Accelerator Centre. 1988. 8p. (In Afrikaans). Available from the CSIR, National Accelerator Centre, P.O Box 72, Faure, 7131, South Africa.

At the National Accelerator Centre a beam buncher is used on the beam line between the injector cyclotron and the open sector cyclotron to change the length of the beam bunchers to such an extent that it has a minimum length distribution at the open sector cyclotron. The stress applied to the beam buncher can not be measured directly. To study the exact effect of the beam buncher on the beam the exact stress on the beam buncher is necessary. An indirect method to measure the beam buncher stress is looked at as well as the extent to which the beam is bunched at normal usage of the beam buncher.

34250 (SAND–89-0081C) **Low emittance foil diode studies for the recirculating linear accelerator (RLA).** Mazarakis, M.G.; Poukey, J.W.; Haworth, M.D.; Smith, D.L.; Hasti, D.E.; Pointon, T.; Bennett, L.F.; Lucero, S.J. Sandia National Labs., Albuquerque, NM (USA). 1989. 16p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890665–3: 7. Institute of Electrical and Electronics Engineers pulsed power conference, Monterey, California, USA, 12-14 Jun 1989). Order Number DE89012638/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

In recent RLA experiments, a foil diode was utilized, followed by a 1.2-m-long 60-mTorr argon gas cell or lower pressure classical IFR transport region. In order to improve the beam capture and transport efficiency, a number of diode configurations were studied both experimentally and numerically using JASON and the latest version of MAGIC code. In particular, a conical shank diode was investigated in detail. A study of the beam current was undertaken using apertures of gradually increasing I.D. steps of 6.4 mm. An excellent agreement between experiment and simulations was observed. MAGIC predicted the exact total diode current, the current through the different radius apertures, and the beam envelope radius. An optimized diode geometry gave at the anode foil a very cold beam of 1.4 MV, 22.5 kA with an rms beam radius r = 1.5 cm and a geometric emittance ϵ = 0.04 rad.cm. The foil and gas transport region lead always to an increase of beam emittance. A similar design for a 4 MV, 10 kA diode is also presented. 8 refs., 7 figs., 1 tab.

34251 (SLAC-PUB–4907) **Online monitoring of dispersion functions and transfer matrices at the SLC.** Emma, P.; Fieguth, T.H.; Lohse, T.; Burchat, P.R.; Panvini, R.S. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Mar 1989. 3p. Sponsored by DOE Energy Research. DOE Contract AC03-76SF00515. (CONF-890335–202: 13. particle accelerator conference, Chicago, Illinois, USA, 20-23 Mar 1989). Order Number DE89013745/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The symmetries of the chromatic correction sections in the SLC Final Focus System allow a high-resolution determination of the pulse-to-pulse energy fluctuations by exploiting the information from beam position monitors (BPMs) in regions of large dispersion. By correlating this signal with other BPMs, one can infer the dispersion function as well as spatial components of transfer matrices anywhere in the arcs and the Final Focus System without interrupting normal machine operation. We present results from data recorded during either periods of stable operation or periods when the linac energy was intentionally varied. 6 refs., 7 figs.

34252 (SLAC-PUB–4919) **Beam-Beam deflection as a beam tuning tool at the SLAC Linear Collider.** Koska, W.; Bambade, P.; Kozanecki, W.; Phinney, N.; Wagner, S.R. Stanford Linear Accelerator Center, Menlo Park, CA (USA); Michigan Univ., Ann Arbor, MI (USA); Colorado Univ., Boulder, CO (USA). Apr 1989. 18p. Sponsored by DOE Energy Research. DOE Contract AC03-76SF00515;AC02-76ER01112;AC02-86ER40253. (UM-HE–89-9;COLO-HEP–195;CONF-890335–201: 13. particle accelerator conference, Chicago, Illinois, USA, 20-23 Mar 1989). Order Number DE89013744/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

To achieve maximum integrated luminosity at the SLAC Linear Collider, a method of noninvasive beam tuning is required. Traditional luminosity monitors based on Bhabha scattering are inadequate because of low instantaneous counting rates. Coherent deflections of one beam by the electromagnetic field of the other are sensitive not only to the relative steering of the two bunches but also to their spot sizes. A brief description of beam-beam deflection theory forms the basis for a discussion of this phenomenon as a

tool for single-beam tuning and for luminosity optimization at the interaction point of the SLC. 13 refs., 5 figs.

34253 (SLAC-PUB–4953) **Design of optics for the final focus test beam at SLAC.** Oide, Katsunobu. Stanford Linear Accelerator Center, Menlo Park, CA (USA). May 1989. 14p. Sponsored by DOE Energy Research. DOE Contract AC03-76SF00515. (CONF-890335–208: 13. particle accelerator conference, Chicago, Illinois, USA, 20-23 Mar 1989). Order Number DE89013742/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The goal of the Final Focus Test Beam experiment (FFTB) is to produce an electron beam spot of 1 μm by 60 nm in transverse dimensions. In the future linear collider of TeV region (TLC), a typical spot size of 100 nm by 1 nm at the interaction point is required to get luminosity of $1 \times 10^{34} cm^{-2} s^{-1}$. This spot size is about 1/1000 of the SLC in the vertical dimension, and is demanding for an optics design, alignments, beam diagnostics, and tuning procedures. The spot size of the FFTB will be an important next step from the SLC toward the TLC. This paper describes the design of the beam optics. 11 refs., 2 figs., 1 tab.

34254 Effects of frequency spreads on beam breakup instabilities in linear accelerators. Colombant, D. G. (Plasma Theory Branch, Plasma Physics Division, Naval Research Laboratory, Washington, DC 20375-5000(US)); Lau, Y. Y. *Applied Physics Letters (USA),* 55(1): 27-29 (3 Jul 1989).

Structure mode frequency spreads are shown to have a rather different influence on beam breakup growths than betatron frequency spreads. The present analytic and numerical studies show that a finite spread in the breakup mode frequency leads to an algebraic decay of the beam breakup instabilities even if the quality factor $Q \rightarrow \infty$. Effects of stagger tuning are examined.

34255 An introduction to the physics of particle accelerators. Edwards, D. A. (Fermi National Accelerator Laboratory(US)); Syphers, M. J. *AIP (American Institute of Physics) Conference Proceedings (USA),* 184(1): 2-189 (1 Apr 1989). (CONF-8707208–: U.S. Particle Accelerator School: physics of particle accelerators, Batavia, Illinois, USA, 20 Jul - 14 aug 1987).

This article is based on our lecture notes prepared for a two-week intensive summer course given at Cornell University in 1988. This was the second year in which the U.S. Particle Accelerator School teamed with a university to arrange courses for which students could receive credit from the host institution. Our course was intended to be introductory in character, emphasizing the basic physics underlying the field of particle accelerators. Hence, no subject was treated in depth; rather a variety of topics was introduced and pursued far enough, we hope, to illustrate the physics at work. (AIP)

34256 Transverse motion of single particles in accelerators. Talman, R. (Cornell University, Ithaca, NY 14853(US)). *AIP (American Institute of Physics) Conference Proceedings (USA),* 184(1): 190-242 (1 Apr 1989). (CONF-8707208–: U.S. Particle Accelerator School: physics of particle accelerators, Batavia, Illinois, USA, 20 Jul - 14 aug 1987).

Any accelerator must have focusing elements, usually magnetic quadrupoles, which hold individual particles close to an ideal central orbit. The purpose of this chapter is to analyse the transverse motion of particles and beams in such systems, with particular emphasis on circular machines. A particle not precisely on the central orbit is subject to a restoring force tending to reduce the deviation and, as a result, the particle oscillates around the central orbit. These oscillations are usually called betatron oscillations when they occur in a circular machine, and we will use the same terminology even for motion in any beam transport system. (AIP)

34257 Fundamentals—longitudinal motion. Weng, W. T. (Brookhaven National Laboratory, Upton, NY 11973(US)). *AIP (American Institute of Physics) Conference Proceedings (USA),* 184(1): 243-287 (1 Apr 1989). (CONF-8707208–: U.S. Particle Accelerator School: physics of particle accelerators, Batavia, Illinois, USA, 20 Jul - 14 aug 1987).

I will cover acceleration and longitudinal motion in a synchrotron. What I hope to add (to the current literature) is a unified overview of the related rf subjects in an accelerator and a close coupling between accelerator physics and engineering practices, which is essential for the major progress in areas such as high intensity synchrotrons, a multistage accelerator complex, and anti–proton production cooling, made possible in the past 20 years. I also hope that after this summer school, you will have the basic knowledge to let you understand the discussion and to ease the way for you to dip into the field if you so choose. (AIP)

34258 Beam observation and the nature of instabilities. Gareyte, J. (CERN, Geneva, Switzerland(CH)). *AIP (American Institute of Physics) Conference Proceedings (USA),* 184(1): 343-429 (1 Apr 1989). (CONF-8707208–: U.S. Particle Accelerator School: physics of particle accelerators, Batavia, Illinois, USA, 20 Jul - 14 aug 1987).

In this manuscript ... we will rather dwell on the various means which have been invented to observe the beams, to track and record their most intimate behavior in order to assess their margin of stability, and finally through a better understanding of their properties to devise ways of increasing the machine performance. Although in this exercise good theories are a necessary ingredient, we will put more emphasis on the almost 'intuitive' understanding of the nature of the fundamental phenomena at work. The first chapter will describe the observable manifestations of an ensemble of particles with no interactions between them. The second and third chapters will study the effect of wake fields on the collective behavior of the beam particles. The basic nature of beam instabilities will be shown with the help of simple examples. (AIP)

34259 Bunched beam diagnostics. Siemann, R. H. (Newman Laboratory of Nuclear Studies, Cornell University, Ithaca, N.Y. 14853(US)). *AIP (American Institute of Physics) Conference Proceedings (USA),* 184(1): 430-471 (1 Apr 1989). (CONF-8707208–: U.S. Particle Accelerator School: physics of particle accelerators, Batavia, Illinois, USA, 20 Jul - 14 aug 1987).

The emphasis of this paper is ... on frequency domain analysis of beam generated signals in storage rings. The goal is to connect spectrum analyzer observations to what the beam is doing. In addition, understanding beam spectra is essential for understanding coherent effects and instabilities in storage rings, and this is discussed extensively. (AIP)

34260 Fields, impedances, and structures. Ng, K. (Fermi National Accelerator Laboratory, Batavia, IL 60510(US)). *AIP (American Institute of Physics) Conference Proceedings (USA),* 184(1): 472-524 (1 Apr 1989). (CONF-8707208–: U.S. Particle Accelerator School: physics of particle accelerators, Batavia, Illinois, USA, 20 Jul - 14 aug 1987).

Beam particles interact directly with other beam particles or indirectly through the electromagnetic fields reflected back from the walls of the vacuum chamber. The interaction between the fields and a bunch may lead to coherent motions of the particles inside the bunch resulting in instabilities. In the frequency domain, we say that the beam current sees longitudinal and transverse impedances due to space charge and the discontinuities of the vacuum chamber. In this chapter, we first discuss the electromagnetic fields left by a particle after traversing some structures of the vacuum chamber. Next, coupling impedances are defined in terms of the wakefields. They are then estimated for various discontinuities in the chamber. (AIP)

34261 Introduction to wakefields and wake potentials. Wilson, P. B. (Stanford Linear Accelerator Center, Stanford, California 94305(US)). *AIP (American Institute of Physics) Conference Proceedings (USA),* 184(1): 525-564 (1 Apr 1989). DOE Contract AC03-76SF00515. (CONF-8707208–: U.S. Particle Accelerator School: physics of particle accelerators, Batavia, Illinois, USA, 20 Jul - 14 aug 1987).

What are wakefields and wake potentials, and why are these concepts useful in the physics of linear accelerators and storage rings? We approach this question by first reviewing the basic physical concepts which underlie the mathematical formalism. We then present a summary of the various techniques that have been developed to make detailed calculations of wake potentials. Finally, we give some applications to current problems of interest in accelerator physics. No attempt at completeness can be made in an introductory article of modest length. Rather, we try to give a broad overview and to list key references for more detailed study. It will also be apparent that the last chapter on this subject, with all the loose ends neatly tied

up, has yet to be written. There are subtle points, there are controversial questions, and active calculations to resolve these questions are continuing at the time of this writing. (AIP)

34262 Characteristics of synchrotron radiation. Kim, K. (Center for X-ray Optics, Accelerator and Fusion Research Division, Lawrence Berkeley Laboratory, Berkeley, CA 94720(US)). *AIP (American Institute of Physics) Conference Proceedings (USA),* 184(1): 565-632 (1 Apr 1989). DOE Contract AC03-76SF00098. (CONF-8707208–: U.S. Particle Accelerator School: physics of particle accelerators, Batavia, Illinois, USA, 20 Jul - 14 aug 1987).

In this paper, we review the principle of various synchrotron radiation sources and their characteristics. Spectral characteristics, the angular distribution, the polarization, and the frequency integrated power of the bending-magnet radiation is discussed. Undulator radiation topics include the undulator harmonics, the spectrum at a given angle, the angular distribution at a given frequency, the effect due to the electron beam distribution, the angle-integrated power, and the polarization. In addition to the mathematical analysis, we emphasize physical understanding based on the properties of the apparent trajectories. The wiggler as a limiting case of an undulator for a large orbit excursion. We establish the conditions under which a wiggler may be regarded as a sequence of bending magnets. A general discussion of the properties of synchrotron at finite, how it propagates through optical medium, how it forms interference patterns, etc., is given. (AIP)

34263 Review of linear collider beam-beam interaction. Chen, P. (Stanford Linear Accelerator Center, Stanford, California 94309(US)). *AIP (American Institute of Physics) Conference Proceedings (USA),* 184(1): 633-679 (1 Apr 1989). DOE Contract AC03-76SF00515. (CONF-8707208–: U.S. Particle Accelerator School: physics of particle accelerators, Batavia, Illinois, USA, 20 Jul - 14 aug 1987).

Three major effects from the interaction of e^+e- beams — disruption, beamstrahlung, and electron-positron pair creation — are reviewed. For the disruption effects we discuss the luminosity enhancement factor, the maximum and *rms* disruption angles, and the kink instability. All the results are obtained from computer simulations. Scaling laws for the numerical results and theoretical explanations of the computor acquired phenomena are offered wherever possible. For the beamstrahlung effects we concentrate only on the final electron energy spectrum resulting from multiple photon radiation process, and the deflection angle associated with low energy particles. For the effects from electron–positron pair creation, both coherent and incoherent processes of beamstrahlung pair creation are discussed. In addition to the estimation on total number of such pairs, we also look into the energy spectrum and the deflection angle.

34264 The linear collider beam-beam problem. Hollebeek, R. (University of Pennsylvania(US)). *AIP (American Institute of Physics) Conference Proceedings (USA),* 184(1): 680-710 (1 Apr 1989). (CONF-8707208–: U.S. Particle Accelerator School: physics of particle accelerators, Batavia, Illinois, USA, 20 Jul - 14 aug 1987).

In this paper, I would like to briefly review some of the early results of beam-beam simulations, point out some of the main features of that work, and add a few comments which have thus far only been given in seminars and talks. The first two sections deal with the mechanics of doing the simulation including some tricks which are employed. This is followed by a general discussion of beam disruption, the question of stability, how the luminosity behaves, and finally a discussion of some particular special cases which are of interest. (AIP)

34265 A quantum treatment of bremstrahlung and its application to ribbon pulses. Blankenbecler, R. (Stanford Linear Accelerator Center, Stanford, CA 94305(US)); Drell, S. D. *AIP (American Institute of Physics) Conference Proceedings (USA),* 184(1): 711-757 (1 Apr 1989). DOE Contract AC03-76SF00515. (CONF-8707208–: U.S. Particle Accelerator School: physics of particle accelerators, Batavia, Illinois, USA, 20 Jul - 14 aug 1987).

In Part I a straightforward high energy expansion is discussed and applied to the problem of radiation from an extended target. In particular, we discuss bremsstrahlung from an electron-pulse collision. A full quantum treatment of the power spectrum and the average energy loss is given. Scaling laws that smoothly join the quantum regime to the classical limit are derived. In Part II the high energy expansion introduced in Part I is used to describe the problem of beamstrahlung due to an extended pulse with an elliptical cross section of arbitrary eccentricity. We show that the transverse geometry of the pulse enters in a remarkably simple scaling manner. This case is of interest because the radiative energy loss can be markedly reduced while simultaneously keeping a fixed luminosity if the beam pulses are very thin in one transverse direction, i.,e. shaped like ribbons. Effects of other types of beam shaping are briefly discussed, and the physics of the process is emphasized.

34266 Methods of beam optics. Willeke, F. (Deutsches Elektronen-Synchrotron DESY, Notkestr. 85, 2000 Hamburg 52, Germany(DE)); Ripken, G. *AIP (American Institute of Physics) Conference Proceedings (USA),* 184(1): 758-819 (1 Apr 1989). (CONF-8707208–: U.S. Particle Accelerator School: physics of particle accelerators, Batavia, Illinois, USA, 20 Jul - 14 aug 1987).

In the following report we give a survey of linear machine theory. Our investigations are restricted to coasting-beam betatron motion but coupling is taken into account in a general way. The equations of motion for on- and off-momentum particles are derived and written in canonical form. From the canonicity it follows that all transfer matrices are automatically symplectic. Eigenvector methods are introduced to study the stability behavior. To investigate the influence of coupling, generalized lattice functions are defined and canonical perturbation techniques are applied.

34267 Nonlinear dynamics. Guignard, G. (CERN, Geneva, Switzerland(CH)). *AIP (American Institute of Physics) Conference Proceedings (USA),* 184(1): 820-890 (1 Apr 1989). (CONF-8707208–: U.S. Particle Accelerator School: physics of particle accelerators, Batavia, Illinois, USA, 20 Jul - 14 aug 1987).

Following an introduction on analytical mechanics, canonical transformations, and perturbation theory, a description is given of nonlinear effects for near-integrable systems associated with resonances, amplitude variations with multiple crossings, adiabatic changes of the parameters, and time variation of the perturbation. Examples of applications coming from observations and calculations related to CERN accelerators concern coupling measurements, intra-beam scattering, beam-beam effects magnetic imperfections, two-beam overlap knockout, and synchro-betatron resonances. Finally, the notions of invariant distortion and aperture of bounded motion in the presence of multipoles are introduced.

34268 Phase space concepts. Michelotti, L. (Fermi National Accelerator Laboratory(US)). *AIP (American Institute of Physics) Conference Proceedings (USA),* 184(1): 891-945 (1 Apr 1989). (CONF-8707208–: U.S. Particle Accelerator School: physics of particle accelerators, Batavia, Illinois, USA, 20 Jul - 14 aug 1987).

In these lectures we shall look at the geometric approach to the study of Hamiltonian dynamical systems, especially in connection with the kinds of problems which arise in accelerator orbit theory. This is a vast subject, and we certainly shall not be able to treat it as fully or as carefully as it deserves. In recent years a number of books have been published on dynamics, and the reader who wants to learn more will find some of these titles included in the bibliography. Our own relatively modest goals will be to delineate the idea of invariant tori in phase space, to define and illustrate the importance of resonant orbits and their separatrices as structures for organizing dynamics, and to touch upon the meaning of chaotic orbits in nonintegrable systems. (AIP)

34269 The description of particle accelerators using high-order perturbation theory on maps. Berz, M. (University of Giessen, West Germany, and Lawrence Berkeley Laboratory(US)). *AIP (American Institute of Physics) Conference Proceedings (USA),* 184(1): 961-994 (1 Apr 1989). (CONF-8707208–: U.S. Particle Accelerator School: physics of particle accelerators, Batavia, Illinois, USA, 20 Jul - 14 aug 1987).

The perturbative description of particle accelerators using Taylor series maps is discussed. A new technique is presented which allows a very efficient computation of high order maps. It is shown how this method can be used to determine maps of the action of various electromagnetic fields including fringe fields, measured fields, and space-charge fields.

34270 Advanced nonlinear theory: Long-term stability at the SSC. Heifets, S. (Continuous Electron Beam Accelerator Facility, 12070 Jefferson Avenue, Newport News, Virginia 23606(US)). *AIP (American Institute of Physics) Conference Proceedings (USA),* 184(1): 1015-1061 (1 Apr 1989). (CONF-8707208–: U.S. Particle Accelerator School: physics of particle accelerators, Batavia, Illinois, USA, 20 Jul - 14 aug 1987).

The SSC is supposed to be one of the most stable dynamic systems. The luminosity lifetime of one day means that particles have to be in a regular, stable, bounded motion for 10^8 revolutions. This is only an order of magnitude less than the lifetime of the solar system. The problem of beam stability, one of the main problems in the theory of accelerators, has many aspects: one-particle dynamics, and intrabeam, beam-environment, and beam-beam interactions. We address here only the first problem—the dynamics of a single particle. (AIP)

34271 A review on the lattice design of large hadron colliders. Lee, S. Y. (Brookhaven National Laboratory, Upton, NY 11973(US)). *AIP (American Institute of Physics) Conference Proceedings (USA),* 184(1): 1062-1083 (1 Apr 1989). (CONF-8707208–: U.S. Particle Accelerator School: physics of particle accelerators, Batavia, Illinois, USA, 20 Jul - 14 aug 1987).

The conceptual evolution of the accelerator lattice design is discussed. Indicated are aspects of IR design. We emphasize the cancellation of stop-band width in the cluster design. The case of symmetric vs antisymmetric design is also discussed. The SSC lattice is used as an example.

34272 The physics of codes. Cooper, R. K. (Los Alamos National Laboratory, Los Alamos, NM 87545(US)); Jones, M. E. *AIP (American Institute of Physics) Conference Proceedings (USA),* 184(1): 1084-1105 (1 Apr 1989). (CONF-8707208–: U.S. Particle Accelerator School: physics of particle accelerators, Batavia, Illinois, USA, 20 Jul - 14 aug 1987).

The plan of this paper is first to describe rather simply the concepts of emittance and brightness, then to describe rather briefly each of the codes TRANSPORT, PARMETQ, TBCI, MARYLIE, and ISIS, indicating what physics is and is not included in each of them. At the outset we will state that since we are dealing with linear machines we will not mention synchrotron radiation. We expect that the vast majority of what we cover will apply equally well to protons and electrons (and other particles). This material is intended to be tutorial in nature and can in no way be expected to be exhaustive. (AIP)

34273 Canonical integrators as tracking codes (or how to integrate perturbation theory with tracking). Forest, E. (SSC Central Design Group, c/o Lawrence Berkeley Laboratory, One Cyclotron Road, Berkeley, California 94720(US)). *AIP (American Institute of Physics) Conference Proceedings (USA),* 184(1): 1106-1136 (1 Apr 1989). (CONF-8707208–: U.S. Particle Accelerator School: physics of particle accelerators, Batavia, Illinois, USA, 20 Jul - 14 aug 1987).

This lecture is about the ideal single-particle code for a large circular machine. This code must be able to track particles and produce high-order maps that can be analyzed by canonical perturbation theory. This lecture will set guidelines for critically judging the existing codes as well as the future codes that some of you might design. (AIP)

4303 Auxiliaries and Components

Refer also to citation(s) 33492, 34247, 35458, 35467, 35468, 35469

34274 (BNL–41899) **Status of the quadrupoles for RHIC [Relativistic Heavy Ion Collider].** Thompson, P.A.; Cottingham, J.G.; Garber, M.; Ghosh, A.; Goodzeit, C.; Greene, A.; Herrera, J.; Kahn, S.; Kelly, E.; Morgan, G. Brookhaven National Lab., Upton, NY (USA). 1989. 4p. Sponsored by DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-890335–199: 13. particle accelerator conference, Chicago, Illinois, USA, 20-23 Mar 1989). Order Number DE89014709/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The proposed Relativistic Heavy Ion Collider (RHIC) will require 408 regular arc quadrupoles. Two full size prototypes have been constructed and tested. The construction uses the single layer, collarless concept which has been successful in the RHIC dipoles. Both the magnets attained short sample current, which is 60% higher than the operating current. This corresponds to a gradient of 113 T/m with clear bore of 80 mm. The preliminary field measurements are in agreement with the calculations, with the exception of an unexpectedly large show sextupole. 2 refs., 5 figs., 1 tab.

34275 (BNL–42448) **A radiation hard dipole magnet coils using aluminum clad copper conductors.** Leonhardt, W.J. Brookhaven National Lab., Upton, NY (USA). 1989. 4p. Sponsored by DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-890335–197: 13. particle accelerator conference, Chicago, Illinois, USA, 20-23 Mar 1989). Order Number DE89014712/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A C-type septum dipole magnet is located 600 mm downstream of the primary target in an external beam line of the AGS. Conventional use of fiber glass/epoxy electrical insulation for the magnet coils results in their failure after a relatively short running period, therefore a radiation hard insulation system is required. This is accomplished by replacing the existing copper conductor with a copper conductor having a thin aluminum skin which is anodized to provide the electrical insulation. Since the copper supports a current density of 59 A/mm^2, no reduction in cross sectional area can be tolerated. Design considerations, manufacturing techniques, and operating experience of a prototype dipole is presented. 3 refs., 4 figs.

34276 (BNL–42812) **UV photoemission from metal cathodes for picosecond power switches.** Fischer, J.; Srinivasan-RAo, T.; Tsang, T. Brookhaven National Lab., Upton, NY (USA). 1989. 26p. Sponsored by DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-8810135–5: Switched-power workshop, Shelter Island, New York, USA, 16-21 Oct 1988). Order Number DE89012975/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Results are reported of photoemission studies using laser pulses of 10 ps duration and 4.66 eV photon energy on metal cathodes. These included thin wires, flat surfaces and an yttrium cathode with a grainy surface. The measurements of current density and quantum efficiency under low and high surface fields indicate that field assisted efficiencies exceeding 0.1% and current densities exceeding 10^5 A/cm^2 are obtainable. The results are compared to the requirements of switch power applications. 24 refs., 13 figs., 1 tab.

34277 (CERN–89-03) **Free-electron laser theory.** Dattoli, G.; Torre, A. European Organization for Nuclear Research, Geneva (Switzerland). 1 Mar 1989. 65p. Order Number DE89620145/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

Lectures given in the Academic Training Programme of CERN 1987-1988.

The essential features of the theory of the free electron laser (FEL) are given in some detail. Beginning with an explanation of the basic gain mechanism, the lectures continue with a discussion of the problems associated with single-passage and recirculated (storage-ring) operation. Pulse propagation effects and the so-called 'lethargic' behaviour are analysed more completely. Finally, elements of FEL quantum theory are reported, in order to clarify the laser process from the microscopic point of view. Appendices give a fuller treatment of optical cavities and undulator magnets.

34278 (CONF-890335–211) **First operational tests of the positive-ion injector for ATLAS.** Bollinger, L.M.; Den Hartog, P.K.; Pardo, R.C.; Shepard, K.W.; Benaroya, R.; Billquist, P.J.; Clifft, B.E.; Markovich, P.; Munson, F.H. Jr.; Nixon, J.M. Argonne National Lab., IL (USA). 1989. 3p. Sponsored by DOE Energy Research. DOE Contract W-31109-ENG-38. From 13. particle accelerator conference; Chicago, Illinois, USA; 20-23 Mar 1989. Order Number DE89014638/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This paper summarizes the status and first operational experience with the positive-ion injector for ATLAS. The new injector consists of an ECR ion source on a 350-kV platform, followed by a superconducting injector linac of a new kind. In Phase I of this project, the ECR source, voltage platform, bunching system, beam-transport system, and a 3-MV injector linac were completed and tested in early 1989 by a successful acceleration of an $^{40}Ar^{12+}$ beam. Most

of the new system operated as planned, and the longitudinal emittance of the 36-MeV beam out of the injector was measured to be only 5 π keV-ns, much smaller than the emittance for the present tandem injector. When completed in 1990, the final injector linac will be enlarged to 12 MV, enough to allow the original ATLAS linac to accelerate uranium ions up to 8 MeV/u. 8 refs., 2 figs.

34279 (CRN-PN–88-16) **Test of the Fugi MB43458 preamplifier in a CERN type drift chamber.** Bergdolt, A.M.; Bing, O.; Ernwein, R.; Gorodetzky, P.; Guterl, P.; Hibou, F.; Westermann, G. Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires. 1988. 12p. (In French). Order Number DE89781554/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

A new amplifying system, to be used in the CERN drift chambers at SPES III, has been realized and tested with a new model at the CRN of Strasbourg. Using a MB 43458 FUJI preamplifier close to the chamber short-circuiting the amplifier part of the existing Lecroy MVL100, it is possible to lower the working voltage of the chamber by 250 volts.

34280 (CRN-VIV–56) **Electric discharges in an electrostatic machine. Analysis of work by J.A. Stanlforth and C.M. Cooke.** Frick, G. Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires. Apr 1988. 26p. (In French). Order Number DE89781526/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Electric discharges, stored energy, and transient phenomena in electrostatic accelerators are reviewed in the framework of the Vivitron project. Before discharge, predischarge phenomena governed by the value of the electric field and the geometry appear. Transient phenomena appear after discharge. The alternance lasts from 20 to 100 nsec. Waves propagating along the electrodes can cause other discharges, after a time lapse. Overvoltages of a factor of 1.5 to 2 can appear. If they provoke fresh discharges, formation times may be such that in many cases the overvoltages remain present throughout times of this order of magnitude. The behavior of a solid insulator under such conditions is unknown, and the behavior inside the tube is poorly understood. If the initial arc is produced outside the tube, a large part of the available energy will be dissipated before the arrival of the overvoltage at the sensitive part of the tube. If the discharge begins in the tube, it will propagate outside because of the short circuit created in the tube by the discharges. For rapid phenomena, it is possible that the spark gaps may not always operate efficiently, especially for vacuum discharges.

34281 (DOE/ER/40150–69) **Modular magnet current regulator.** Dobeck, N.; Burtner, G.; LaMora, R. Southeastern Universities Research Association, Newport News, VA (USA). Continuous Electron Beam Accelerator Facility. [1989]. 6p. Sponsored by DOE Energy Research. DOE Contract AC05-84ER40150. (CEBAF-PR–89-011). Order Number DE89012314/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A modular power regulation system has been developed to handle the many low-power correction and focusing magnets used for beam transport. The system consists of numerous 32-channel assemblies, each containing a bulk power supply, CAMAC control crate, and card cage space for current regulators. Regulators are linear, bipolar modules capable of parallel connection for higher power output. 4 figs.

34282 (FNAL-TM–1586) **Numerically controlled oscillator for the Fermilab booster.** Crisp, J.L.; Ducar, R.J. Fermi National Accelerator Lab., Batavia, IL (USA). Apr 1989. 2p. Sponsored by DOE Energy Research. DOE Contract AC02-76CH03000. (CONF-890335–196: 13. particle accelerator conference, Chicago, Illinois, USA, 20-23 Mar 1989). Order Number DE89013723/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

In order to improve the stability of the Fermilab Booster low level rf system, a numerically controlled oscillator system is being constructed. Although the system has not been implemented to date, the design is outlined in this paper. The heart of the new system consists of a numerically synthesized frequency generator manufactured by the Sciteq Company. The 3 Ghz/sec rate and 30 to 53 MHz range of the Booster frequency program required the design of a CAMAC based, fast-cycling (1 MHz), 65K X 32 bit, digital function generator. A 1 MHz digital adder and 12 bit analog to digital converter will be used to correct small program errors by phase locking the oscillator to the beam. 6 refs., 1 fig.

34283 (FNAL-TM–1589) **Raising the acceptance of the AP2-line.** Trbojevic, D. Fermi National Accelerator Lab., Batavia, IL (USA). 5 Apr 1989. 12p. Sponsored by DOE Energy Research. DOE Contract AC02-76CH03000. Order Number DE89013725/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The 120 GeV Main Ring proton beam collides with the target at the end of the AP-1 line and creates antiprotons and other secondary particles. The AP-2 line transfers the negative particles from the target to the Debuncher. To provide a bigger antiproton stack size in the Accumulator, both the Debuncher as well as the AP-2 line acceptance have to be raised. This is a proposal for the improvement of the AP-2 line acceptance. The first part of the memo presents an acceptance examination of the existing AP-2 line by computer simulation, while the second presents a short proposal for aperture corrections. The computer program TURTLE was used to trace antiprotons through the AP-2 line without taking into account other negative charged particles. Betatron functions were obtained from the output of the SYNCH computer program. The SYNCH program was also used to check the dispersion match between the AP-2 line and the Debuncher. 3 refs., 6 figs., 5 tabs.

34284 (FNAL-TM–1594) **Neutron spectral measurements in the D0 collision hall.** Yurista, P.M.; Elwyn, A.J.; Salsbury, W.C. Fermi National Accelerator Lab., Batavia, IL (USA). 3 May 1989. 14p. Sponsored by DOE Energy Research. DOE Contract AC02-76CH03000. Order Number DE89013386/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The characterization of radiation fields is important to many applications. For example, in operational health physics, the choice of instrumentation for monitoring and of a personnel dosimeter for use by radiation workers depend on both the type and spectral characteristics of the radiation. Furthermore, the spectral distribution of the fluence affects radiation damage estimates for materials for new or replacement equipment within the radiation environment. At the same time, knowledge of the character of the radiation fields at a high-energy accelerator leads to a better theoretical understanding of its nature, and is important to the specification of civil construction requirements for future upgrades of the accelerator. At Fermilab as at many high-energy accelerators neutrons dominate the radiation fields outside of beam pipes within enclosures. In a continuing effort to characterize as completely as possible the fields at various locations around the site, we have measured the neutron spectrum within the DO collision hall. Both the fluence and dose-equivalent energy distributions are summarized in this note. 12 refs., 4 figs., 2 tabs.

34285 (FNAL-TM–1596) **The Fermilab Central Computing Facility architectural model.** Nicholls, J. Fermi National Accelerator Lab., Batavia, IL (USA). May 1989. 6p. Sponsored by DOE Energy Research. DOE Contract AC02-76CH03000. (CONF-890415–4: Computing in high energy physics, Oxford, UK, 10-14 Apr 1989). Order Number DE89014633/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The goal of the current Central Computing Upgrade at Fermilab is to create a computing environment that maximizes total productivity, particularly for high energy physics analysis. The Computing Department and the Next Computer Acquisition Committee decided upon a model which includes five components: an interactive front end, a Large-Scale Scientific Computer (LSSC, a mainframe computing engine), a microprocessor farm system, a file server, and workstations. With the exception of the file server, all segments of this model are currently in production: a VAX/VMS Cluster interactive front end, an Amdahl VM computing engine, ACP farms, and (primarily) VMS workstations. This presentation will discuss the implementation of the Fermilab Central Computing Facility Architectural Model. Implications for Code Management in such a heterogeneous environment, including issues such as modularity and centrality, will be considered. Special emphasis will be placed on connectivity and communications between the front-end, LSSC, and workstations, as practiced at Fermilab. 2 figs.

34286 (GANIL-A–88-03) **Capacitive large-range-intensiy beam-position monitors at Ganil.** Loyer, F.; Doutressoulles, C.; Ducoudret, B.; Rataud, J.P.; Daudin, F. Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France). 1988. 3p. Order Number DE89781546/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

At GANIL, to allow a permanent measurement of the ion beam position, we are designing a non-interceptive beam position monitor. After having given the technical specifications - in particular a large intensity range 60dB - this paper describes the technical choices of made after theoretical studies: - capacitive electrodes loaded by 50 Ω amplifier, - 10 KHz heterodyne to detect the 2nd harmonic of the electrode signals, - amplitude-to-phase conversion followed by a phasemeter to detect the beam position. At the end of this paper, the first results obtained with a prototype monitor are given, in particular their good accordance with the theoretical calculation and the few problems still to solve.

34287 (GANIL-A–88-05) **Ganil D.C. power converters: improvements of the response to mains fluctuations. Mains voltage harmonic filtering.** Dugay, G. Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France). 1988. 3p. Order Number DE89781542/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

After a brief review of the methods used to simulate the mains steps, we describe the modifications brought to our DC Converters in order to protect them against the mains fluctuations. It was mostly necessary to avoid the disjunctions due to the excessively sensitive protective and relay systems and to improve the time-response of the electronic drive stages. The second part deals with the description of a 20 KV two cells harmonic filter used to reduce voltage distorsions on the 20 KV GANIL network.

34288 (IFVE-OUNK–88-11) **Longitudinal coupling impedance of cyclic accelerator vacuum chamber with small cross-section variations. 2. Tests of method and impedance of the UNK chamber elements.** Kurennoj, S.S.; Purtov, S.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij. 1988. 18p. (In Russian). Order Number DE89620138/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Submitted to the journal Zh. Tekh. Fiz.

The longitudinal coupling impedance of conical transitions and fast demountable joints in the vacuum chamber of the UNK first stage is calculated. It is shown that the impedance produced by these elements is essentially less than the upper bound imposed by the longitudinal stability requirements. 6 refs.; 10 figs.; 3 tabs.

34289 (INS–718) **Honeycomb sandwich structure vacuum jacket for cryogenic targets.** Harada, M.; Kasai, S.; Kato, S. and others. Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study. Nov 1988. 18p. Order Number DE89778052/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Cryogenic targets (H_2, D_2 and ^4He) have been built for use in the study of photonuclear reactions with π sr spectrometer, TAGX at the 1.3 GeV Tokyo electron synchrotron. A new type of vacuum jacket fabricated from plastic honeycomb core and Mylar skins has been used in the target system for more than 5000 hours. The average radiation thickness and the average density of this jacket are measured to be 3.3×10^{-3} X_0 and 0.15 g/cm^3, respectively.

34290 (INS–726) **Lasertron, a pulsed RF-source using laser triggered photocathode.** Yoshioka, Masakazu. Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study. Dec 1988. 30p. Order Number DE89778130/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

A new pulsed RF-source, 'Lasertron', are being developed as a possible RF-power source for future electron-positron linear colliders. In a series of systematic study, a prototype lasertron has been fabricated and tested. A peak power of 80 kW is attained at 2.856 GHz RF-frequency in 1-μs time duration. This paper describes the experimental results of the lasertron including the developments of the photocathode and the laser system. Test results are compared with the analysis of beam dynamics in the lasertron.

34291 (JAERI-M–88-149, pp. 96-102) **Injector of linac for free electron laser.** Asami, Akira (National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan)). Japan Atomic Energy Research Inst., Tokyo (Japan). Aug 1988. (In Japanese). (CONF-8803200–: 1. workshop on the free electron laser, Tokai, Japan, 1 Mar 1988). In *Proceedings of the free electron laser workshop, 1988 JAERI.* Order Number DE89780071/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

The report outlines several aspects of the injector of inic for free electron laser, focusing on required characteristics, problems to be solved, and possible solutions. In particular, studies underway in SLAC and LANL are outlined, and the detailed structures of injectors which have been proposed based on these studies are described. First, required characteristics of electron beams for free electron laser are discussed. The energy should meet the widely known resonance requirements. The electron beam emittance should be very small to produce coherent laser beams. The deviation of energy should be very small so that interactions between electron beam and laser beam can occur all over the wigler region. The electric current of electron beams should be as large as possible to obtain a maximum laser output. Detailed discussions are then made of the emittance, bunch and energy spectrum. There are various factors in the increase in the emittance of electron beams after injection. Such factors include the deviation of the beam energy, electromagnetic field induced by the beam, space charge, and radiofrequency characteristics. Calculations of the energy deviation, increase in bunch and magnetic bunching are also described. Finally, some practical injectors which have been constructed or proposed are briefly outlined. (N.K.).

34292 (JINR–9-88-533) **Simulation of an axially symmetric ion-optical system.** Biri, S.; Bogomolov, S.L. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions. 1988. 10p. (In Russian). Order Number DE89620129/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Submitted to the journal Zh. Tekh. Fiz.

The simulation of an electrostatic axially symmetric ion-optical system designed for forming an ion beam extracted from an ion source has been carried out. The design of an ion-optical system with an axial electric potential distribution consisting of linear and cosine terms is considered. The electrode shape and electric potentials are determined from the given potential distribution on the axis. The properties of the ion-optical system designed in this manner have been verified using the code ELENS. It is shown that the ion-optical systems constructed by the proposed method practically provide the same quality of the beam as do other systems known from the literature. The proposed method of constructing an ion-optical system does not require bulky numerical calculations. 8 refs.; 6 figs.

34293 (JINR–13-88-486) **Determination of neutral particle concentration at erosion laser plasma expansion into vacuum.** Mironov, V.E. Joint Inst. for Nuclear Research, Dubna (USSR). 1988. 5p. (In Russjan). Order Number DE89620128/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Experimental setup and methods for erosion laser plasma neutral component by ion probing are described. Laser ion source was used. Time distribution of neutral particle density at 5 cm from a point of plasma forming at laser radiation flux density q in (2×10^7/ 2×10^9)Vxcm^{-2} range for various target materials were obtained. Obtained distributions were approximated by Maxwell velocity distributions. 6 refs.; 4 figs.

34294 (JINR–13-88-575) **Secondary-emission sensors of JINR phasotron proton beam.** Belyaev, A.L.; Shabashov, M.F.; Shishkin, A.L. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems. 1988. 10p. (In Russian). Order Number DE89620151/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Constructions and principle of operation of two secondary-emission sensors of JINR phasotron proton beams are described. The first of them is intended for investigation of parameters of circulating proton beam. Theoretical and experimental data confirming its work capability for >130 MeV proton energy range are presented. Basing on first measurements it is shown that deviation of beam core verically with respect to geometrical centre of accelerator magnetic system does not exceed 15 mm for >50 cm radii. Taking into

account maximum estimation of total vertical dimension of the beam obtained in the same measurement it is concluded that proton beam at acceleration should not touch the accelerating RF system construction with aperture of 100 mm. The second monitor described permits to control the intensity and profile of the extracted proton beam at beam currents more than 0.05 μA. 10 refs.; 8 figs.; 1 tab.

34295 (JINR-E–9-88-445) **Synthesis method for the design of relativistic magnetically-focused beam sources.** Aleksakhin, Yu.I. Joint Inst. for Nuclear Research, Dubna (USSR). 1988. 6p. Order Number DE89620125/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Submitted to the 7. International conference on high-power particle beams, Karlsruhe, FRG, July 4-8, 1988.

A system of equations governing stationary laminar space-charge flow is presented. In the case of solid axisymmetric flow it is reduced to a set of ordinary differential equations in the longitudinal coordinate. In the vicinity of the cathode the solution is given in the form of power series. A synthesis method of relativistic Pierce-type gun design is proposed, employing the obtained set of equations. 6 refs.; 1 fig.

34296 (JINR-R–9-88-365) **Electrostatic focusing of the JINR phasotron beam.** Vorozhtsov, S.B.; Glazov, A.A.; Dmitrievskij, V.P. and others. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems. 1988. 8p. (In Russian). Order Number DE89620142/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Electrostatic beam focusing system for the JINR phasotron is described. The system is mounted into the centre of accelerator for reducing particle losses in axial motion. The peculiarity of the system is an alternating focusing. It is realized due to dummy dee modification by introducing the radial focusing gaps. The focusing electrode is at a constant negative voltage. Using the electrostatic focusing system allowed one to decrease twice effective dimension of beam and to reduce Z-losses of particles. As a result, the beam intensity increased by 1.5 times for amplitude of accelerating voltage of 40 kV. Maximum internal beam intensity achieved was 9.2 mkA with rotation velocity of frequency variation of 2400 turns/min. 3 refs.; 8 figs.; 2 tabs.

34297 (JINR-R–9-88-472) **Stretching of JINR phasotron beam at minimum of frequency program.** Vorozhtsov, S.B.; Glazov, A.A.; Dmitrievskij, V.P. and others. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems. 1988. 8p. (In Russian). Order Number DE89620143/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

The method of synchrocyclotron postacceleration by means of an additional accelerating element-C-electrode-is used in JINR Phasotron for time stretching of accelerated proton beam. To increase the beam capture efficiency by the C-electrode the Phasotron accelerating system was modified in such a way, that the accelerating voltage frequency was a minimum at the moment of particle extraction, i.e. the dee frequency program time derivative achieves zero. At the same time, the working regime of the stretching system was optimized. Numerical simulation and experiments on beam stretching under these conditions were carried out. As a result, the beam capture coefficient increased approximately 1.5 times reaching the level of (75-80)%. 3 refs.; 9 figs.; 1 tab.

34298 (JINR-R–9-88-508) **About the generation of uniform magnetic field in injector part of the LIU-30 accelerator.** Zhidkov, E.P.; Zhuravlev, V.V.; Kladnitskij, V.S.; Matora, I.M.; Fedorov, A.V.; Yuldashev, O.I. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation. 1988. 11p. (In Russian). Order Number DE89620136/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Submitted to the journal Zh. Tekh. Fiz.

Coaxial ferromagnetic shims are used for generating a uniform magnetic field inside and between sections of injector part of the linear induction accelerator LIU-30. The shim dimensions and positions, as well as parameters of some focusing solenoids were found by numerical simulation. The shim configuration constraints conditioned by the possibilities of convenient exploitation of the existing accelerator devices were taken into account. Numerical simulations show that using of ferromagnetic shims allows to generate the uniform magnetic field with the deviation from the average value by less than 1-2% inside the sections and by 8% between the sections. 10 refs.; 4 figs.

34299 (JINR-R–9-88-542) **Use of Pockels effect for measurement of accelerating field in linear induction accelerators.** Gorchakov, V.K.; Kutsaenko, V.V.; Potapov, V.T.; Zhabitskij, V.M.; Kaminskaya, A.M.; Makoveev, B.K.; Mel'nikov, V.A.; Fateev, A.A. Joint Inst. for Nuclear Research, Dubna (USSR). 1988. 8p. (In Russian). Order Number DE89620149/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

The Pockels type sensor is proposed for measuring local and integral parameters of accelerating fields in linear accelerators (LIA). The sensor is based on electrooptical Pockels effect in $Bi_{12}SiO_{20}$ crystal. The effect could be considered as two-ray refraction induced by electric field. The change of light polarization state is transformed into amplitude modulation of intensity. The light radiation pulses go via multimode filament light guide. Space resolution is limited by sensor (not worse than 1 cm). Time resolution is limited by speed of response of photodetector (not worse than 10 ns). The sensor allows one to measure electric field strength in the 30 upto 1500 kV/m voltage region. It provides isolation of high-volatge sources and has a good noise immunity of data transmission line. Automatic measurements of electric field distribution in a module of LIA section were performed by means of this sensor. 8 refs.; 5 figs.

34300 (JINR-R–9-88-644) **Analysis and correction of magnetic field inhomogeneities in the superconducting dipoles of the nuclotron.** Donyagin, A.M.; Eliseeva, I.A.; Kovalenko, A.D. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy. 1988. 7p. (In Russian). Order Number DE89620144/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

The sources of magnetic field inhomogeneities at a level of 10^{-3}-10^{-4} to the main field harmonic in the superconducting dipole magnets of the Nuclotron, a 6 GeV/nucl. strong focusing synchrotron for relativistic nuclei, which is being constructed at the Laboratory of High Energies, have been analyzed. The way of correction of skew harmonics (dipole, quadrupole ets.) in the "window frame" type of dipole magnets was suggested and tested. This allowed the ratio of the sum of skew nonlinearities to the main harmonic to be decreased to $(1\text{-}2)\times10^{-4}$ in the working aperture for serial dipole magnets of the Nuclotron. 5 refs.; 3 figs.; 2 tabs.

34301 (JINR-R–9-88-675) **Microprocessor control subsystem for extream control of the U-400 cyclotron beam current by variation of ion source regime.** Kas'yanov, A.A.; Rybin, V.M.; Kutner, V.B.; Sukhov, A.M.; Tret'yakov, Yu.P.; Subbotin, V.G.; Fefilov, B.V. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions. 1988. 7p. (In Russian). Order Number DE89620150/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Submitted to the journal Prib. Tekh. Ehksp.

A microprocessor subsystem for the control of an arctype multicharged ion source is described. The subsystem allows one to automatically produce and sustain the present current of the ion beam from the U-400 cyclotron by varying the parameters of the ion source operation. The step-coordination method of searching for the extremum is used, with the checking of the satisfaction of the condition of parameter limitations. The subsystem puts the ion source into the present mode of operation for 10-15 minutes with up to 5% deviations from the present parameters and stabilizes the beam current within 3%. 8 refs.; 3 figs.

34302 (KEK–88-3, pp. 163-167) **Heil UCN source with accelerators.** Yoshiki, H. (National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan)). National Lab. for High Energy Physics, Oho, Ibaraki (Japan). Jun 1988. (CONF-8803216–: 1. KEK symposium on ultra cold neutrons (UCN), Tsukuba, Japan, 10 Mar 1988). In *1st KEK symposium on ultra cold neutrons (UCN).* Order Number DE89012146/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

The ultra-cold neutrons (UCN) are essential class of neutrons for measuring the electric dipole moment (edm) and studying other properties of the neutron. There have been successful ways of producing UCN for experiments. Golub and Pendlebury proposed a

method by superthermal liquid helium where produced phonons take away the heat of incoming cold neutrons. The present proposal is also based on this principle. The proposed Japanese Hadron Project envisages a wide variety of experiments concerning hadron interactions in four arenas dedicated to kaon, meson, neutron and exotic nuclei physics respectively. The accelerators to support this are a 2 GeV synchrotron, a stretcher/synchrotron hybrid ring, a 1 GeV 200 μA proton linac and a heavy ion linac. It is therefore proposed that an ultra-cold neutron target station will be constructed in the complex and achieve the strongest UCN source in the world. An estimate based on 7 x 10^{12} $cm^{-2}s^{-1}$ thermal neutron flux produced by ~1 GeV, 20 μA primary electron beam gives ~5 x 10^{3} $cm^{-3}s^{-1}$ UCN production, about 50 times stronger than Gatchina, although the thermal flux itself is very much smaller than those at ILL. The technical problems of installing HeII in the thermal or cold neutron fields have been examined and shown solvable. (N.K.).

34303 (LBL–24979) **Behavior of power-limited transverse stochastic cooling systems.** Goldberg, D.A.; Lambertson, G.R. Lawrence Berkeley Lab., CA (USA). Jul 1988. 13p. Sponsored by DOE Energy Research. DOE Contract AC03-76SF00098. Order Number DE89013388/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Analysis of stochastic cooling systems is usually done under the assumption that the system performance is not limited by the available electronic gain. In practical systems, it may prove to be the case that cost-induced limitations on the maximum available output power restrict the maximum attainable gain, thereby restricting it to be less than its optimal value. Such is the case in the anti-proton sources at both CERN and Fermilab. The criteria that one would employ in, for example, upgrading such a power-limited system prove to be rather different from those for a system for which one can optimize the gain. In the following sections we first develop the formulas relevant to the behavior of power-limited cooling systems; we limit our treatment throughout to the case of systems which cool the transverse phase space of the beam. We then discuss the implications of our results for the upgrade of such cooling systems, contrasting this case with that for systems in which the electronic gain can be optimized. Finally, we apply our results to the specific case of the Fermilab debuncher ring. 3 refs., 1 fig., 2 tabs.

34304 (LBL–26246) **An industrial cabling machine for the SSC.** Royet, J.; Armer, R.; Hannaford, R.; Scanlan, R. Lawrence Berkeley Lab., CA (USA). Feb 1989. 3p. Sponsored by DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-890270–19: International industrial symposium on the super collider, New Orleans, Louisiana, USA, 8-10 Feb 1989). Order Number DE89013422/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The SSC project will need the manufacturing of some 25,000 kilometers of keystoned flat cable. The technical specifications of the various cables to be produced are the result of five years of research and development work at LBL. An experimental cable machine was built and run in the laboratory; many improvements were implemented and tested. Semi-industrial production of the various cables was performed, and the resulting cables were used and tested in the one-meter model magnets and 17.5 meter dipole prototypes. From these experiments an industrial cabler specification was generated and used for an international RFQ. The winner of the contract is Dour Metal, a Belgium company that built the first industrial prototype which is now in a production line at New England Electric Wire Company. In this paper we describe the main characteristics of the machine and give the first industrial production results of superconducting keystoned cable for the SSC project. 4 refs.

34305 (LBL–27162) **Ion beam modification of the Y-Ba-Cu-O system with the MEVVA high current metal ion source.** Brown, I.G.; Rubin, M.D.; Yu, K.M.; Mutikainen, R.; Cheung, N.W. Lawrence Berkeley Lab., CA (USA). Mar 1989. 5p. Sponsored by DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-890426–18: Spring meeting of the Materials Research Society, San Diego, California, USA, 24-28 Apr 1989). Order Number DE89013687/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We have used high-dose metal ion implantation to 'fine tune' the composition of Y-Ba-Cu-O thin films. The films were prepared by either of two rf sputtering systems. One system uses three modified Varian S-guns capable of sputtering various metal powder targets; the other uses reactive rf magnetron sputtering from a single-mixed-oxide stoichiometric solid target. Film thickness was typically in the range 2000–5000 A. Substrates of magnesium oxide, zirconia-buffered silicon, and strontium titanate have been used. Ion implantation was carried out using a metal vapor vacuum arc (MEVVA) high current metal ion source. Beam energy was 100–200 keV, average beam current about 1 mA, and dose up to about 10^{17} ions/cm^2. Samples were annealed at 800–900°C in wet oxygen. Film composition was determined using Rutherford Backscattering Spectrometry (RBS), and the resistivity versus temperature curves were obtained using a four-point probe method. We find that the zero-resistance temperature can be greatly increased after implantation and reannealing, and that the ion beam modification technique described here provides a powerful means for optimizing the thin film. 23 refs., 4 figs.

34306 (SAND–88-3335C) **RADLAC-II accelerator pulsed power upgrade results.** Smith, D.L.; Shope, S.L.; Hasti, D.E. Sandia National Labs., Albuquerque, NM (USA). 1989. 18p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890665–24: 7. Institute of Electrical and Electronics Engineers pulsed power conference, Monterey, California, USA, 12-14 Jun 1989). Order Number DE89013565/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The completed upgrade of the 20-MeV RADLAC-II linear induction accelerator (LIA) is being evaluated. The upgrade includes improvements in the electron beam energy, current, beam quality, and accelerator reliability. The design goals of 2.5 MV/stage, 40-kA peak current, >40-ns pulse width, >20-ns flattop, and a 1-cm radius annular beam have been met or exceeded by the injector and by the injector plus two accelerating gaps. These results agree with circuit simulation predictions. A description of the accelerator and a comparison of pulsed power experimental measurements with circuit model waveforms are presented. 15 refs., 7 figs., 2 tabs,

34307 (SAND–88-3427C) **A double post-hole vacuum convolute diode for z-pinch experiments on Saturn.** Spielman, R.B.; Corcoran, P.; Fockler, J.; Kishi, H.; Spence, P.W. Sandia National Labs., Albuquerque, NM (USA). 1989. 5p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890665–13: 7. Institute of Electrical and Electronics Engineers pulsed power conference, Monterey, California, USA, 12-14 Jun 1989). Order Number DE89013165/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We have successfully tested a double post-hole vacuum convolute for driving z-pinch loads on Saturn (32 TW, 1.9 MV, 40 ns FWHM, and 0.11 Ω). We use the lower four insulators to feed four, conical self-magnetically insulated disk feeds (MITLs). The disk MITLs are convoluted using six anode posts (and cathode holes) to a single disk MITL (L ~ 10 nH). A peak current of 12.5 MA was delivered to a low inductance short circuit load and 10.5 MA was delivered to a gas puff z-pinch load. Electron losses in the vacuum feed have been acceptable. 5 refs., 5 figs.

34308 (SAND–89-0299C) **Generation of lithium ions for ion sources using the 670.8 nm resonant transition of lithium.** Tisone, G.C.; Bieg, K.W.; Dreike, P.L. Sandia National Labs., Albuquerque, NM (USA). 1989. 16p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890703–5: International conference on ion sources, Berkeley, California, USA, 9-15 Jul 1989). Order Number DE89013089/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This paper describes research on two methods of producing a singly ionized lithium plasma 1-mm thick with an areal density up to 1 x 10^{16} cm^{-2}. The first method relies on forming a 1-mm-thick layer of lithium vapor by ohmically pulse heating a thin film of a lithium bearing compound. The vapor is then ionized by 670.8 nm laser light, the first resonant transition of lithium. Small scale experiments described here demonstrated average electron densities up to 5 x 10^{16} cm^{-3}, using laser energy densities as low as 20 mJ/cm^2. The second method is direct heating, evaporation, and ionization of thin lithium bearing films on thermally insulating substrates using 670.8 nm laser light. The minimum tuned laser energy density for producing a plasma was 0.15 J/cm^2. These results are compared with measurements at other wavelengths and pulse lengths, and with models of the heating and ionization. 11 refs., 3 figs., 2 tabs.

34309 (SLAC-PUB–4974) **Monitoring in future e^+e^- colliders.** Erickson, R.A. Stanford Linear Accelerator Center, Menlo Park, CA (USA). May 1989. 13p. Sponsored by DOE Energy Research. DOE Contract AC03-76SF00515. (CONF-8810356–2: 3. joint US-Cern accelerator school on particle accelerators: frontiers of particle beams, observations, diagnosis, and correction, Capri, Italy, 20-26 Oct 1988). Order Number DE89013741/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Study groups throughout the world have recently been examining possible parameter choices for a TeV-class linear collider. In all cases, they have concluded that in order to achieve useful luminosity within plausible cost constraints, the opposing beams of electrons and positrons must be focused to extraordinarily small spots and steered into collision with an unprecedented degree of accuracy. Some means of monitoring these beam parameters will be essential in order to guide the focusing and steering. In this talk, examples will be presented which illustrate the nature of these new requirements, along with a discussion of the limitations of conventional techniques for monitoring such beams and some recent measurements from the SLAC Linear Collider that show how the next level of resolution in beam monitoring will be achieved. 19 refs., 12 figs., 1 tab.

34310 (UCRL–100122) **Computer code prediction of picosecond voltage switching and TEM wave generation in air gas avalanche switches.** Mayhall, D.J.; Yee, J.H.; Villa, F. Lawrence Livermore National Lab., CA (USA). 1 Jun 1989. 6p. Sponsored by DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-890665–15: 7. Institute of Electrical and Electronics Engineers pulsed power conference, Monterey, California, USA, 12-14 Jun 1989). Order Number DE89013778/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The realization of efficient, reliable picosecond closing switches will make possible high gradient (1–3 GeV) linacs with pulsed accelerating electrode structures. Recently a promising candidate for picosecond, high voltage switching, the gas avalanche switch, has been proposed. The medium in this switch is high pressure (10–800 atm) gas. An avalanche discharge is initiated between pulse-charged high voltage electrodes by multiphoton ionization from a picosecond order laser pulse. The laser-initiated electrons avalanche toward the anode, causing the applied voltage to collapse in picoseconds, long before the hot current channel formation of a conventional spark gap. Several versions of the gas avalanche switch may be conceived. A parallel plate capacitor version consists of a high pressure gas confined between two parallel metal plates. An analysis of the formation or voltage delay and voltage collapse times for this geometry has been done by Villa and Cassell by numerical integration of a zero-dimensional (OD) electric circuit equation, which includes a resistively limited charge feed. This analysis predicts voltage collapse times of the order of several picoseconds for N_2 and air and 1 psec or less for Ar. 6 refs., 7 figs.

34311 **The tevatron energy doubler.** Edwards, H.T. (Fermi National Accelerator Lab., Batavia, IL (US)). v.v of Annual review of nuclear and particle science. Volume 35, 1985. Jackson, J.D.; Gove, H.E.; Schwitters, R.F. Annual Reviews Inc., Palo Alto, CA (1985).

The Tevatron project is a massive upgrade of the original Fermilab accelerator complex, which became operational in 1972 and operated from 1973 until mid-1982 at typically 400 GeV and 2 x 10^{13} protons per pulse (ppp). The three parts of the Tevatron project when complete will allow for both fixed-target and collider hadron physics using primary beam energies in the 800-1000 GeV range. The Fermilab facility should thus be able to maintain its position at the forefront of high-energy physics research facilities. This paper describes the superconducting accelerator phase of the program Because the new synchrotron provides protons with twice the energy of the old Main Ring, it is frequently called the Energy Doubler. It first accelerated a beam in July 1983 and is presently operating at 800 GeV with intensities above 1 x 10^{13} ppp.

4304 Storage Rings

Refer also to citation(s) 34048

34312 (BNL–42582) **X-ray microscopy using synchrotron radiation.** Jones, K.W.; Gordon, B.M.; Hanson, A.L.; Pounds, J.G.; Rivers, M.L.; Schidlovsky, G.; Smith, J.V.; Spanne, P.; Sutton, S.R. Brookhaven National Lab., Upton, NY (USA). 1989. 18p. Sponsored by DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-890748–8: Microbeam Analysis Society meeting, Asheville, North Carolina, USA, 16-21 Jul 1989). Order Number DE89010569/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The system for x-ray microscopy now being developed at the X-26 beam line of the Brookhaven National Synchrotron Light Source (NSLS) is described here. Examples of the use of x-ray microscopy for trace element geochemistry, biology and medicine, and materials investigations are given to emphasize the scientific applications of the technique. Future directions for the improvement and further development of the X-26 microscope and of the x-ray microscopy field in general are discussed. 11 refs., 7 figs.

34313 (KEK–88-8) **Injection of 1 GeV H^- beam into the JHF I-A ring.** Yamane, Isao; Kitagawa, Kiyoshi; Someya, Hirohiko; Yano, Yoshiharu. National Lab. for High Energy Physics, Oho, Ibaraki (Japan). Nov 1988. 40p. Order Number DE89778071/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Application of the H^0 injection method to the injection system of the JHF I-A ring was studied. It turned out that the H^0 injection method is adequate when some conditions are fulfilled. The ways to fulfill those conditions are described.

34314 (LUNTDX-NTMX–1001-1-133-1988) **Non-linear transverse dynamics for storage rings with application to the low-energy antiproton ring (LEAR) at CERN.** Bengtsson, J. Lund Univ. (Sweden). Max-laboratory. 11 Apr 1988. 137p. Order Number DE89618173/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

A tensor equation has been used to derive the equations of motion for the curvilinear coordinate system customary used for accelerators. A Hamiltonian formalism, expanded to third order in the canonical variables, describing the transverse motion in an acceleration has also been developed. Time-dependent perturbation theory has been applied and computerized using a computer algebra system. In particular, the perturbations due to magnetic sextupoles have been calculated to second power in the sextupole strength. The frequency spectra for the betatron motion close to a single resonance has been calculated by using time-independent perturbation theory. It has been shown that information about excited resonances and the type of driving field can be derived from the spectra. In particular, it is possible to obtain the amplitude and the phase of a given resonance. The results have been used to study the perturbations in the Low Energy Antiproton Ring, LEAR at CERN. (With 67 refs.)

34315 **Beam-beam collision scheme for storage-ring colliders.** Oide, K. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94309(US)); Yokoya, K. *Physical Review [Section] A: General Physics (USA),* 40(1): 315-316 (1 Jul 1989). DOE Contract AC03-76SF00515.

It is shown that a scheme of beam-beam collisions which makes a head-oncollision in a transversely boosted frame is applicable to storage-ringcolliders. This scheme allows a large crossing angle at the collision pointwithout an excitation of synchrotron-betatron resonances, and will give meritsin designing high-luminosity colliders.

34316 **Comments on nonlinear dynamics studies in storage rings.** Chao, A. W. (SSC Central Design Group, Lawrence Berkeley Laboratory, Berkeley, California 94720 USA(US)). *AIP (American Institute of Physics) Conference Proceedings (USA),* 184(1): 946-960 (1 Apr 1989). (CONF-8707208–: U.S. Particle Accelerator School: physics of particle accelerators, Batavia, Illinois, USA, 20 Jul - 14 aug 1987).

Nonlinear dynamics of storage rings are discussed. Canonical perturbation theory, resonances, the Hamilton–Jacobi Equations, tracking simulations, explicit canonical integration, Taylor and Lie maps, and differential algebra are topics discussed. Results from the Fermilab experiment E778 which studied nonlinear dynamics in the Tevatron at 150 GeV are presented. (AIP)

44 INSTRUMENTATION

4401 Radiation Instrumentation

Refer also to citation(s) 34246, 34763, 34770, 34860, 34861, 34878, 34945, 34946, 35148, 35193, 35238

34317 (AD-A–201238/3/XAB) **Analytical/experimental investigation of corpuscular radiation detectors. Final report, 1 May 1985-31 August 1987.** Grossi, M.D. Raytheon Co., Portsmouth, RI (USA). Submarine Signal Div. 15 Sep 1987. 26p. Available from NTIS, PC A03/MF A01.

The following approaches were investigated, with the aim of identifying methods for the detection of low-energy neutrinos' promising enough to deserve an experimental verification: (1) Cryogenic sensor of neutrinos' radiation pressure; (2) Magnetic interaction sensor; (3) Superheated Superconducting Colloid (SSC) Calorimeter; (4) sensor of the neutrino interaction with superconducting electrons; and (5) Bolometric sensor with silicon interaction target. Approaches 1, 2, and 3 were found deserving of experimental verification, but project funding limited continuing effort to approaches 1 and 2. Furthermore, DARPA added another task to the project, and this action further limited funding for the remaining approaches 1 and 2. The added task consisted of Raytheon verification of Prof. Weber's claim that he has detected ion-energy neutrinos with room-temperature instrumentation.

34318 (ANL-HEP-CP–89-48) **General considerations for SSC scintillator calorimeters (For the scintillator general subgroup).** Nodulman, L. Argonne National Lab., IL (USA). 1989. 3p. Sponsored by DOE Energy Research. DOE Contract W-31109-ENG-38. (CONF-890379–7: Workshop on calorimetry for the SSC, Tuscaloosa, Alabama, USA, 13-17 Mar 1989). Order Number DE89014674/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The Scintillator Calorimetry group divided into three subgroups: a conventional uranium and plate design ala ZEUS, fiber design, and a group on general considerations. The considerations of the third group are reported here on geometrical and technical issues. 1 fig.

34319 (CONF-890379–6) **Summary talk on fiber tower calorimeter for the scintillation calorimeter subgroups.** White, A.P.; Walker, J.K.; Johnson, C.; Wahl, H.; Gabriel, T. Florida Univ., Gainesville, FL (USA). 1989. 22p. Sponsored by DOE Energy Research. DOE Contract FG05-86ER40272. From Workshop on calorimetry for the SSC; Tuscaloosa, Alabama, USA; 13-17 Mar 1989. Order Number DE89013005/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

We present here a new calorimeter design based on small scintillator tiles, lead absorber and wavelength shifting fiber readout. We have addressed all the major issues in SSC calorimetry and have developed a design with many advantageous features. It has been well demonstrated that the best resolution is obtained for a 'compensated' calorimeter. It is also well known how such compensation may be achieved by a suitable choice of active and passive materials and their relative thickness. One such choice is that of lead and scintillator for which the best thickness ratio is 4:1. This selection has been used in the development of the so-called spaghetti calorimeter (SPACAL) discussed at this workshop. The relative merits of this and many other designs have been the subject of much discussion at SSC workshops from which a number of critical issues have emerged for each design. In the present paper, we have addressed the issues raised in the SPACAL design and proposed an alternative, improved design. The SPACAL represents a significant step forward in calorimeter design, but there are always areas which can be improved in any design when it is subjected to detailed study. Specifically we have considered the areas of energy resolution, channeling, projective towers/calibration, longitudinal segmentation, and radiation sensitivity. We will now discuss each of these areas in turn. 5 refs., 9 figs.

34320 (CRN-PN–89-05) **Associated particle technique for absolute neutron counting efficiency determination.** Guillaume, G.; Huck, A.; Wagner, P.; Baumann, P.; Costa, G. Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires. 1989. 11p. Order Number DE89781592/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The $^{7}Li(p,n)^{7}Be$ reaction has been used to produce neutrons with energies ranging from 8 to 13 MeV in order to measure the absolute neutron counting efficiency of a large NE213 scintillator by the associated particle method. Recoil ^{7}Be nuclei were detected with a ΔE(gas)-E (solid) telescope in coincidence with neutrons. The method is suitable for neutron energies greater than 1.2MeV and could be applied to establish the neutron efficiency response of any detector.

34321 (DOE/ER/40125–21) **Indiana University High Energy Physics Group, Task E: Technical progress report, December 1, 1988–November 30, 1989.** Alyea, E.D. Jr. Indiana Univ., Bloomington, IN (USA). Dept. of Physics. 1989. 42p. Sponsored by DOE Energy Research. DOE Contract AC02-84ER40125. Order Number DE89013109/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This progress report for Task E of the Indiana University High Energy Physics Group covers the period June 1, 1988 to May 31, 1989. During this time we worked on several aspects of the development of the Large Volume Detector (LVD) at the Gran Sasso Laboratory in Italy. We finished our gas flow studies for the recirculating and purification system for the limited streamer gas and aided, on a consulting basis, our colleagues at Frascati with the technical specifications for the gas system which they plan to buy from industry. Our major efforts were devoted to design of the tracking trigger, plans for cabling of the whole detector, and learning about the L3 database system. 3 refs., 2 figs., 2 tabs.

34322 (FNAL-TM–1592) **Modifications and tests of MWPC Mu0.** Crittenden, R.; Lui, R.; Smith, P.; Welch, K.; Krider, J. Fermi National Accelerator Lab., Batavia, IL (USA). Apr 1989. 21p. Sponsored by DOE Energy Research. DOE Contract AC02-76CH03000. Order Number DE89013722/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

E711 MWPC DC5 is on long term loan to E672 from the FNAL physics department. It was received at Indiana University (Bloomington) in May 1988. This paper is a summary of the testing and modifications that were done on this chamber. The chamber is now referred to as Mu0. 11 figs.

34323 (GANIL-P–89-01) **NE-213 Liquid scintillator, neutron detector designed for lifetime measurements of very neutron-rich nuclei.** Mueller, A.C.; Bazin, D.; Schmidt-Ott, W.D. Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France). 1989. 31p. Order Number DE89781596/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The design and construction of a coincidence detector destined for lifetime and delayed-neutron emission probability measurements is discussed. Its operating in the context of the LISE spectrometer at the GANIL facility is described. Results are given which illustrate the performance and reliability of this detector.

34324 (IFVE-ONF–88-52) **Scintillation hodoscopes for time-of-flight measurements in the SIGMA-AYaKS installation.** Antipov, Yu.M.; Gorin, Yu.P.; Bilen'kij, M.S. and others. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij. 1988. 15p. (In Russian). Order Number DE89620304/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The results of studying the scintillation counters used for time-of-flight measurements in the SIGMA-AYaKS spectrometer are presented. The counters used are 150, 65 and 10 cm long, the cross section is 10x1.5 cm, the type of scintillator is NE110. The counter time resolutions for minimum ionizing particles in the order of reducing their length are σ_t=0.18, 0.14 and 0.11 ns. The main contribution to resolution is made by the photoelectron statistics due to the time of light emission and to the difference of the optical ways of light in the counter. The scintillation counters are assembled into hodoscopes with dimensions 1.5x3.2 m and 0.65x0.8 m which are used for particles identification in the time-of-flight measurements. The algorithms of off-line data processing are presented. 16 refs.; 13 figs.; 4 tabs.

34325 (INIS-mf–11451, pp. 45-49) **X-ray apparatus for welded joints testing.** Basler, G. Ceskoslovenska Vedeckotechnicka Spolocnost, Bratislava (Czechoslovakia). Dom Techniky. Mar 1988. (In Slovak). (CONF-8803218–: Welding '88 - 3. conference on nondestructive testing of welded joints, Brno, Czechoslovakia, 3-4 Mar 1988). In *Welding '88. Nondestructive testing of welded joints.* Order Number DE89618174/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Briefly presented are shortfalls of conventional a.c. X-ray instruments when used in testing welded joints in nuclear power plants. These shortcomings are eliminated by the use of d.c. X-ray instruments. Their disadvantage, however, is higher weight, the complicated design of the whole equipment and higher cost. Described is a d.c. X-ray instrument powered with 160 kV obtained from a medium frequency (20 kHz) a.c. voltage supply. This technically demanding circuitry substantially reduces the instrument weight. Attention is also paid to optimizing the focus. For nuclear technology, instruments of 0.2 to 1.5 mm in focal length are satisfactory, this depending on power output. Examples are given of radiograms obtained with a 160 kV tube. (Z.M.). 4 figs., 1 tab.

34326 (INIS-mf–11456, pp. 431-434) **Relationship between nuclear physics and ionizing radiation dosimetry.** Spurny, F. (Ceskoslovenska Akademie Ved, Prague (Czechoslovakia). Ustav Dozimetrie Zareni). Jednota Ceskoslovenskych Matematiku a Fyziku, Prague (Czechoslovakia). 1987. (In Czech). (CONF-8707217–: 9. conference of Czechoslovak physicists, Pardubice, Czechoslovakia, 6-10 Jul 1987). In *Ninth conference of Czechoslovak physicists. Part 1, 2.* Order Number DE89617602/JAW. Available from NTIS (US Sales Only), PC A22/MF A01 - OSTI; INIS.

Examples are given to demonstrate what knowledge of nuclear physics is immediately used in the dosimetry of ionizing radiation and which methods and procedures of dosimetry contribute new knowledge to nuclear physics. Both carried out at the Institute of Radiation Dosimetry. They include, e.g., the research of characteristics of interactions of ionizing radiation, calculations of energy carried by neutrons, activation detectors, thermoluminescence detectors, dielectric track detectors, the detection and dosimetry of high energy particles, etc. (M.D.). 4 figs., 13 refs.

34327 (INIS-SU–78, pp. 249-253) **On the possibility of measuring the cross section intermediate neutron radiative capture with high degree of capture and scattering separation.** Shchepkin, Yu.G. (AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij). Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij. 1988. (In Russian). (CONF-870959–: 1. international conference on neutron physics, Kiev, USSR, 14-18 Sep 1987). In *Neutron physics. Vol. 2.* Order Number DE89012115/JAW. Available from NTIS (US Sales Only), PC A16/MF A01; INIS.

The possibility of using the time-of-flight and filtered neutron beam methods of separation of the neutron radiative capture and scattering are considered. 13 refs.; 3 figs.

34328 (INS–728) **New aspects and new tools in hypernuclear studies. Experiments with a superconducting toroidal spectrometer.** Yamazaki, T.; Aoki, M.; Fujita, Y. and others. Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study. Dec 1988. 27p. Order Number DE89778132/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The experimental program with a new superconducting toroidal spectrometer system which will be installed in a new low-momentum K-meson beam line at KEK is discussed based on the recent development of hypernuclear studies using stopped-K^- reactions. Current topics, such as bound Σ hypernuclei, weak pionic decays of Λ hypernuclei and production of Λ hypernuclei via direct and indirect reactions, are described.

34329 (IPNO-DRE–87-33(3)) **Compact fast data acquisition and data analysis system for time of flight mass spectrometry. Time and S.I. intensity measurements with a new multistop TDC.** Della-Negra, S.; Le Beyec, Y. Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire. 1987. 5-8p. (CONF-8709132–: 6. international conference on secondary ion mass spectrometry - SIMS VI, Versailles, France, 13-18 Sep 1987). Order Number DE89781423/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

A data acquisition and processing system for time of flight mass spectrometry, based on a PC-AT computer with an additional memory card was developed, and analysis software was written. About 100,000 counts/sec can be analyzed and stored in the memory. In the coincidence mode, 1000 start events with 10 stop events (per sec) on one time digital converter allow 10 spectra to be recorded. Examples of printouts are shown.

34330 (IPNO-DRE–87-33(4)) **Pulsed Cs ion gun for time of flight mass spectrometry.** Della-Negra, S.; Depauw, J.; Le Beyec, Y. Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire. 1987. 9-12p. (CONF-8709132–: 6. international conference on secondary ion mass spectrometry - SIMS VI, Versailles, France, 13-18 Sep 1987). Order Number DE89781424/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

A pulsed ion gun was built for surface analysis of organic and inorganic solid layers. Secondary ion mass analysis is made by time of flight measurements. In the spectrometer, MeV ions from a Cf252 source can also be used to bombard the same targets. The principle of the apparatus is similar to the Manitoba system (Standing et al, 1982), but the Cs ion source (Ionex) and the geometrical arrangement are different. Typical measurement results from experiments using the equipment are illustrated.

34331 (IPNO-DRE–88-39) **Very low-energy conversion electron detection (VLECED) system at the Isocele on-line isotope separator, Orsay.** Kilcher, P.; Sauvage, J.; Munsch, J.; Obert, J.; Caruette, A.; Ferro, A.; Boissier, G.; Fournet-Fayas, J.; Ducourtieux, M.; Landois, G. and others; ISOCELE Collaboration. Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire. 1988. 24p. Order Number DE89781566/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

A system designed and installed at the on-line isotope separator ISOCELE II allows the high resolution detection of low-energy conversion electrons (down to 1 keV) emitted by mass separated radioactive sources: the use of a special tape transport permits both the slowing down of the incoming beam of radioactive ions up to a collection point and the acceleration of the electrons emitted by the collected sources brought to a flat magnetic spectrograph. Typical spectra so obtained are presented.

34332 (ISN–87-83) **Light particle correlations at very small relative momenta.** Merchez, F.; Kox, S.; Perrin, C.; Mistretta, J.; Gondrand, J.C.; Imouk, L.N.; Gretillat, P. Schwarz, E. Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires. 1987. 10p. (CONF-8710373–: Riken-IN2P3 symposium on heavy-ion collisions, Shimoda, Japan, 11-15 Oct 1987). Order Number DE89781517/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

The characteristics of a new detection device for light charged particle correlations are described. This set-up, designed for measurements at very low relative momenta, allows new possibilities in the study of correlation functions. The results obtained on the system $^{20}Ne + {}^{27}Al$ at 30 MeV/nucleon are used to illustrate these new approaches in the analysis.

34333 (JINR–13-88-391) **Study of characteristics of charge sensitive preamplifiers made on discrete and integral elements.** Belyaev, A.K.; Fominykh, V.I.; Sajdimov, Ya.A. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems. 1988. 4p. (In Russian). Order Number DE89620297/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Comparative measurements of noise and time properties of charge sensitive preamplifiers (CSPO) of three types: PSC-44 firm SCHLUMBERGER carried out on discrete elements; A-255 - firm AMPTEK on integral elements and soviet CSPA made on integral elements are carried out. CSPA made on integral elements have the following advantages: compactness, high technology qualities, reliability, small power consumption. All these features cause their successfull application in installations with a large of detectors. 4 refs.; 7 figs.; 2 tabs.

34334 (JINR–13-88-468) **Technology of flanger and supporting elements for cylindrical multiwire chambers.** Vanko, J.;

Kravchuk, N.P.; Nekrasov, K.G.; Filippov, A.I.; Fursov, A.P. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems. 1988. 11p. (In Russian). Order Number DE89620307/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Technology and results of testing the cylindrical multiwire proportional chamber flangers and supporting cylinders are described. The flangers are casted from a compound based on epoxy resin. The supporting cylinders are glued of several mylar layers. 5 refs.; 7 figs.; 2 tabs.

34335 (JINR–13-88-512) **Some fast logic units for high energy physics experiments.** Kondrashov, V.D. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems. 1988. 11p. (In Russian). Order Number DE89620308/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Some blocks of fast electronics (speed of response up to 200 MHz) are described. The blocks could be used for creating logic and time ratii of different experimental setups (coincidence circuit, fan-out, mean timer, digital delay). Their technical characteristics are presented. The blocks are developed in CAMAC standard. 2 refs.; 7 figs.

34336 (JINR–13-88-577) **High pressure streamer chamber serving as a target for investigating the interaction of pions with light nuclei.** Konstantinov, K.R.; Korneev, B.E.; Lyashenko, V.I. and others. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems. 1988. 10p. (In Russian). Order Number DE89620309/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Submitted to the Organizing Committee of the International Symposium Mesons and Light Nuclei, Septembre 1988, CSSR.

The physical program of investigating double charge exchange and dibaryon systems is presented. The results obtained previously in this field are described. In the Laboratory of Nuclear Problems of the JINR an experimental installation has been set up including a streamer chamber-target in magnetic field designed to study pion double charge exchange on helium and carbon nuclei involving the production of multi-prong events with low-energy particles at the vertex. In the streamer chamber high-temperature centres along the particle track arise that represent optical inhomogeneities in gas detected by means of laser illumination. The utilization of a powerfull nitrogen laser for illumination makes possible the use of photographic film of low sensitivity up to 10 units of GOST, USSR. The described method provides for a spatial resolution 10 times, higher than in a conventional streamer chamber. The chamber operates with light gases, such as H_2,D_2, He^4,He^3, as well as with their admixtures with CH at high gaseous pressures. The chamber is provided with an external trigger for selecting the events of interest. 13 refs.; 7 figs.

34337 (JINR–13-88-618) **FASTBUS modules for elementary particle spectrometers.** Weis, M.; Korolev, V.S.; Man'yakov, P.K. and others. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy. 1988. 6p. (In Russian). Order Number DE89620310/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Submitted to the Organizing Committee of the 13-th International Symposium on Nuclear Electronics, Bulgaria, 1988, and to the journal Prib. Tekh. Ehksp.

FASTBUS-CAMAC interface modules used for the construction of elementary particle spectrometers are being developed at the Laboratory of High Energies, JINR. The following FASTBUS modules have been developed to date: a 16-channel 8-bit ADC module with a conversion time of 20 ns, a 8-channel fast ADC module with an internal buffer memory (256 8-bit words), a 16-channel time-to-digital converter capable of operating at a speed of 300 MHz; a 32-channel input shift register with a speed of 200 MHz; a diagnostic module displays the FASTBUS signal activity and power line status, a FASTBUS kluge card. A CAMAC module for connection of the FASTBUS system and the host computer with the aid of a FIORI module has also developed. 3 refs.; 5 figs.

34338 (JINR–13-88-619) **FASTBUS recording System for measurement of time intervals and analog signals for the Sphere spectrometer.** Afanas'ev, S.V.; Anisimov, Yu.S.; Weis, M. and others. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy. 1988. 6p. (In Russian). Order Number DE89620311/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Submitted to the Organizing Committee of the 13-th International Symposium on Nuclear Electronics, Bulgaria, 1988 and to Prib. Tekh. Ehksp.

A FASTBUS recording system used to measure time intervals and fast analog signal at the SPHERE spectrometer is described. The system is based on a 16-channel 8-bit ADC FASTBUS module, a 16-channel 16-bit TDC FASTBUS module and a FIORI interface module connected to CAMAC registers realized data transfer between a FASTBUS segment and a CAMAC dataway. The operation of the system is controlled by an Electronika-60 microcomputer connected to a CAMAC crate controller. The software used in the system provides communication between the FASTBUS segment and the computer, module testing, data acquisition and processing, and result presentation. 7 refs.; 5 figs.

34339 (JINR-R–1-88-523) **Vertex determination from coordinate information of showers in tracking detectors.** Volod'ko, A.G. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems. 1988. 18p. (In Russian). Order Number DE89620306/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

In this paper it is proposed the method for vertex determination from coordinate information of shower in multiwire proportional chamber. The method was introduced and checked in particular case of the forward part of the NA-4 experiment for deep inelastic muon scattering. It is shown that this procedure can be useful enough as supplementary ones to other methods for vertex determination or independently when other methods fail. 7 refs.; 12 figs.

34340 (JINR-R–10-88-455) **Polarized neutron spectrometer. Distributed system for experiment automation on the base of microcomputer and CAMAC microprocessor controllers.** Guenther, S.; Dokukin, E.B.; Elizarov, O.I.; Zhironkin, G.F.; Zhukov, G.P.; Korneev, D.A.; Loebner, M.; Michaelis, B.; Ostrovnoj, A.I. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics. 1988. 8p. (In Russian). Order Number DE89620295/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Hardware and software for decentralized control of spectrometer and experiment are described. The system is based on SM-1300 microcomputer and two CAMAC microprocessor controllers coupled by communication lines. There is language of interpreter to implement programs by user for experiment control under different regimes of operation of spectrometer and measuring equipment. The programs are stored at the SM-1300 disk and can be loaded into microprocessor controller memory via communication line. Experimental data are transferred from microprocessor controller to SM-1300 through communication line, recorded on a disk and registered in data base. After the end of experiment data base is used for automation of off-line processing of accumulated spectra. 12 refs.; 2 figs.

34341 (KEK–88-3, pp. 48-65) **UCN gravitational spectrometer. Fall-focusing ultra cold neutron scattering equipment.** Kawabata, Yuji (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). National Lab. for High Energy Physics, Oho, Ibaraki (Japan). Jun 1988. (In Japanese). (CONF-8803216–: 1. KEK symposium on ultra cold neutrons (UCN), Tsukuba, Japan, 10 Mar 1988). In *1st KEK symposium on ultra cold neutrons (UCN)*. Order Number DE89012146/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

Concept design is carried out of two types of ultra cold neutron scallering equipment using the fall-focusing principle. One of the systems comprises a vertical gravitational spectrometer and the other includes a horizontal gravitation analyzer. A study is made of their performance and the following results are obtained. Fall-focusing type ultra cold neutron scattering equipment can achieve a high accuracy for measurement of energy and momentum. Compared with conventional neutron scattering systems, this type of equipment can use neutron very efficiently because scattered neutrons within a larger solid angle can be used. The maximum solid angle is nearly 4π and 2π for the vertical and horizontal type, respectively. Another feature is that the size of equipment can be reduced. In the present concept design, the equipment is spherical with a diameter of about 1 m, as compared with NESSIE which is

6.7 m in length and 4.85 m in height with about the same accuracy. Two horizontal analyzers and a vertical spectroscope are proposed. They are suitable for angle-dependent non-elastic scattering in the neutron velocity range of 6~15 m/s, pure elastic scattering in the range of 4~7 m/s, or angle-integration non-elastic scattering in the range of 4~15 m/s. (N.K.).

34342 (KEK–88-3, pp. 83-88) **UCN microscopy. Measurement by ultracold neutron microscopy at ILL.** Ebisawa, Tohru (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.). National Lab. for High Energy Physics, Oho, Ibaraki (Japan). Jun 1988. (In Japanese). (CONF-8803216–: 1. KEK symposium on ultra cold neutrons (UCN), Tsukuba, Japan, 10 Mar 1988). In *1st KEK symposium on ultra cold neutrons (UCN).* Order Number DE89012146/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

The author worked for a year at ILL, where experiments with UCN microscopy were under way using a newly constructed strong UCN source. The present report describes the new VCN (very cold neutron) and UCN (ultracold neutron) sources at ILL and outlines the present status of the development of UCN microscopy. At ILL, large-scale works for improvement of the reactor core were carried out, which provided an opportunity to implement a plan to achieve efficient production of VCN out of a cold neutron source. VCN, derived vertically upward, reaches the UCN turbine only after passing through several film layer of less than 1 mm. A thin, high-reflectance mirror has been developed to be used with the neutron conduit. The mirror serves very effectively in reducing the radiation damage, heat generation and VCN loss in the neutron conduit. The UCN microscope developed by the Munich Group, coupled with the new, strong UCN source at ILL, has achieved a magnification of 250 and resolution of 10 micrometers. The microscope is a two-mirror system comprising a concave parabolic mirror and convex spherical mirror. The performance is investigated by measuring the UNC intensity at the image mirror that changes with object slit scanning. (N.K.).

34343 (KEK–88-6, pp. 140-144) **Searching for the quark-gluon plasma.** Koltick, D.S. (Purdue Univ., West Lafayette, IN (USA)). National Lab. for High Energy Physics, Oho, Ibaraki (Japan). Sep 1988. (CONF-8802137–: Workshop on physics of quark-gluon-plasma, Tsukuba, Japan, 18-20 Feb 1988). In *Proceedings of the workshop on physics of quark-gluon-plasma.* Order Number DE89780072/JAW. Available from NTIS (US Sales Only), PC A07/MF A01.

In the present report, the search for the quark-gluon plasma is discussed in relation with proton-antiproton collisions. Hadronic matter at extremely high density is a large unexplored region of physics which experiments are just now starting to investigate. Matter at high density exists naturally in various forms and illustrates well the physical richness of such systems. QCD should predict the behavior of hadronic matter at these densities, just as QED should be capable of explaining electrically charged matter which interacts in bulk. As a check of the correctness of this assumption, one can turn to experiments done at the highest energy e^+e^- colliders. Here parts of first, second and third order in the theory can be checked down to distance scales of 10^{-18} cm. The check can be done by simply looking at the R-ratio, i.e. the ratio of hadronic production to muon pair production, as well as other effects in the production of hadrons. If QCD should start to fail, for example if new color fields should appear or the fundamental part effects would alter the R-ratio. More subtle effects such as changes in the strength of the interaction will show up in the multiplicity distribution of produced hadrons and in other ways. Under the data from TRISTAN, a limit can be set on the minimum hadronic density at which QCD could fail. (N.K.).

34344 (KEK-PR–88-1, pp. 128-141) **Submillimeter spectrum of the cosmic background radiation.** Matsumoto, T. (Nagoya Univ. (Japan). Dept of Astrophysics). National Lab. for High Energy Physics, Oho, Ibaraki (Japan). 1988. (CONF-8802136–: 2. workshop on elementary-particle picture of the universe, Tsukuba, Japan, 4-6 Feb 1988). In *Proceedings of the second workshop on elementary-particle picture of the universe.* Order Number DE89780073/JAW. Available from NTIS (US Sales Only), PC A20/MF A01.

Absolute measurement of the sky brightness is necessary in order to obtain an accurate cosmic backround radiation (CBR) spectrum. The report briefly describes the results of rocket observation with cold optics which was carried out to collect accurate data below the millimeter region. The sounding rocket was launched in February 1987. The submillimeter radiometer used consists of a horn antenna and photometer both of which are cooled down to 1.0 K. Radiation is collected by the horn antenna with a throughput of 0.16 cm^2sr and a 7.6deg FWHM field of view. The radiation is modulated at 6.5 Hz by a cold chopper at the entrance of the photometer. The modulated beam is separated by a series of dichroic beam splitters, enabling simultaneous observation in six passbands. The characteristic features of this radiometer are that the instrumental thermal background is negligible compared with 3 K CBR and that the passbands of filters have a sharp cutoff. In the Wien part of the CBR spectrum, a distortion of the spectrum is expected from several theories. The most familiar one of them is inverse Compton scattering due to high energy electrons. An effort is made to fit the obtained data to this model so that the model gives the highest possible Rayleigh-Jeans temperature. An excess radiation energy density is found to exist which amounts to ~10 % of CBR. (N.K.).

34345 (KFKI–1988-74/H) **Two-dimensional position sensitive X-ray detector.** Kocsis, M. Hungarian Academy of Sciences, Budapest (Hungary). Central Research Inst. for Physics. Dec 1988. 23p. (In Hungarian). Order Number DE89620320/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The basic element of small-angle X-ray and neutron scattering experiments is the two-dimensional detector that produces the image of the X-ray or neutron beam scattered on the specimen, in the plane at a certain distance from the specimen. A two-dimensional multiwire gas proportional chamber with charge division position encoding is described. A position resolution of 1.75 mm could be achieved. The detector operates at atmospheric pressure with flowing Ar - C_4H_{10} gas mixture. (R.P.) 4 refs.; 13 figs.

34346 (LAPP-EXP–87-08) **Recent results and prospects on superheated superconducting granules detectors.** Gonzalez-Mestres, L.; Perret-Gallix, D. Grenoble-1 Univ., 74 - Annecy (France). Lab. de Physique des Particules. Nov 1987. 32p. (CONF-8710218–: International workshop on superconductive particle detectors, Torino, Italy, 26-29 Oct 1987). Order Number DE89781500/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The basic properties of superheated superconducting granules (SSG) detectors are reviewed. Recent results are presented and discussed. Granule samples of different sizes (10 μm < PHI < 400 μm) and impurity content ($6x10^{-8}\Omega.cm$ < p, residual < 10^{-6} $\Omega.cm$) exhibit encouraging sensitivity to low energy β and γ sources (down to ^{55}Fe 6 KeV γ'S). All tests were performed with real-time read-out electronics, detecting single granule flips under the action of individual particles. Sensitivity is shown to depend on normal state resistivity. Irradiation of very large tin granules (45 $\mu m \leq$ PHI $\leq$ 400 μm) with α particles (^{241}Am, $E \simeq 5.5$ MeV) shows evidence for local heating, where the observed energy threshold is far below the one predicted by equilibrium thermodynamical calculations. Tests made at lower temperatures ($T \geq 450$ mK) show the absence of avalanche effect (seen by other authors in different conditions) for several samples of tin granules. A theoretical discussion of the avalanche effect is presented. The understanding of the role of heat exchanges in the composite medium leads to the concept of 'localized micro-avalanche' and opens the way to drastic improvements of SSG performance for particle detection. Such a phenomenon should be obtained by a better thermal matching between dielectric and granules, working at temperatures where the released latent heat is slightly positive. Estimates of the behavior of the detector at very low T are also given, where a thin layer of normal electrons near the surface is shown to contribute to the heat capacity of a superheated granule. We discuss the main points to be studied in the near future, and give a brief evaluation of the present status of feasibility investigation for several proposed experiments (solar neutrinos, monopoles, dark matter, double β,...).

34347 (LBL–26997) **Material parameters in a thick hydrogenated amorphous silicon detector and their effect on signal collection.** Qureshi, S.; Perez-Mendez, V.; Kaplan, S.N.; Fujieda, I.; Cho, G.; Street, R.A. Lawrence Berkeley Lab., CA (USA). Apr 1989. 6p. Sponsored by DOE Energy Research. DOE Contract

AC03-76SF00098. (CONF-890426–19: Spring meeting of the Materials Research Society, San Diego, California, USA, 24-28 Apr 1989). Order Number DE89012978/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Transient photoconductivity and ESR measurements were done to relate the ionized dangling bond density of thick hydrogenated amorphous silicon (a-Si:H) detectors. We found that only a fraction (~30–35%) of the total defect density as measured by ESR is ionized when the detector is biased into deep depletion. The measurements on annealed samples also show that this fraction is about 0.3. An explanation based on the shift of the Fermi energy is given. The measurements show that the time dependence of relaxation is a stretched exponential. 8 refs., 4 figs., 1 tab.

34348 (LYCEN-T–8746) **Neutrons and light nuclei detectors realization for the 4π multidetector amphora.** Pastor, C. Lyon-1 Univ., 69 - Villeurbanne (France). Inst. de Physique Nucleaire; Lyon-1 Univ., 69 - Villeurbanne (France). 1987. 71p. (In French). Order Number DE89781573/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

Detection of light charged particles emitted in reactions induced by heavy ions has been studied. Several types of detectors are presented as phoswiches of scintillators, single scintillators or combinations of scintillators having different functions (either detection of charged particles only or detection of charged particles and neutrons). The AMPHORA 4 π detection array has been designed and built as a set of 140 of these cells. Il covers a solid angle of 82 % out of 4 π around a target bombarded by ion beams delivered by the SARA facility in Grenoble.

34349 (OEVS-Mitteilung–1988, pp. 199-203) **Method for direct determination of the 'working level'.** Tschirf, E. (Atominstitut der Oesterreichischen Universitaeten, Vienna (Austria)); Tschurlovits, M.; Tuerk, M. Oesterreichischer Verband fuer Strahlenschutz (OeVS), Vienna (Austria). Nov 1988. (In German). (CONF-860969–: 4. European congress and 13. regional congress of the International Radiation Protection Association, Salzburg, Austria, 15-19 Sep 1986). In *4. European congress and 13. regional congress of IRPA. 20 years experience in radiation protection - a review and outlook.* Order Number DE89613806/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

A method capable of direct determination of radon daughter products in 'working level' units is described. It consists of the usual collection of the activity in a zellulose nitrate filter; the alpha radiation is detected by exposure of thermoluminescent detectors. The advantages of the method are the simple evaluation of the TDLs by standard devices, and in the temporal independence of the evaluation. The features of the procedure and first measurements are described. 5 refs., 3 figs., 1 tab.

34350 (PPA-T–79) **Calibration of nuclear data WBC-6000 counter system for I-131 thyroid counting.** Idris Besar; Mohamad Yusof Mohamad Ali; Bustami Abu. Unit Tenaga Nuklear, Bangi, Selangor (Malaysia). [1989]. 6p. Order Number DE89618253/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Calibration results in terms of percent efficiency in the thyroid are developed. The calibration was performed by using Nuclear Data Inc. phantom with two radionuclides as standard source, i.e. Ce-139 and Cs-137.

34351 (PTB-Ra–22) **Studies on quality assurance in the determination of activities of radiopharmaceuticals in nuclear medicine.** Debertin, K.; Schrader, H. Physikalisch-Technische Bundesanstalt, Braunschweig (Germany, F.R.). Radioaktivitaet. Feb 1989. 23p. (In German). Order Number DE89783055/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The activity of radiopharmaceuticals is routinely measured by activimeters (radionuclide calibrators) calibrated for radionuclides relevant to nuclear medicine. In this work the influence of the measurement conditions (measuring geometry, sample type, radionuclidic impurities) on the activity value indicated by these instruments is studied quantitatively. Round robins for several radionuclides show what uncertainties are found in practical activity measurements.

34352 (RAL–89-018) **Development of the ZEUS Central Tracking Detector.** Brooks, C.B.; Cashmore, R.J.; Bullock, F.W. and others; ZEUS - UK Collaboration. Rutherford Appleton Lab., Chilton (UK). Feb 1989. 12p. (CONF-890231–: 5. international wire chamber conference, Vienna, Austria, 13-17 Feb 1989). Order Number DE89620312/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The design concept and development of the ZEUS Central Tracking Detector is described. This is a cylindrical drift chamber designed for track reconstruction, electron identification and event triggering in a high crossing-rate, high magnetic field environment.

34353 (SLAC-PUB–4939) **Conclusions from the Engineering Subgroup of the SSC Liquid Argon Calorimeter Working Group.** Bederede, D.; Cooper, W.; Kroon, P.; Lobkowicz, F.; Mason, I.; Mulholland, G.; Pohlen, J.; Schindler, R.H.; Scholle, E.A.; Watanabe, Y. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Jun 1989. 11p. Sponsored by DOE Energy Research. DOE Contract AC03-76SF00515. (CONF-890379–9: Workshop on calorimetry for the SSC, Tuscaloosa, Alabama, USA, 13-17 Mar 1989). Order Number DE89013743/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The SSC Calorimeter workshop was organized to explore the feasibility of each calorimeter technology for use in a 4π detector at the SSC. The Liquid Argon Calorimeter group further subdivided into four subgroups; Hermeticity, Engineering, Module Details, and Electronics. This is the report of the Engineering Subgroup whose charge was to evaluate the cost, schedule, manpower, safety, and facilities requirements for the construction of a large liquid argon calorimeter for the SSC. 4 figs., 4 tabs.

34354 (UCRL–21154) **An instantaneous CCN [cloud condensation nucleus] spectrometer.** Hudson, J.G. Lawrence Livermore National Lab., CA (USA); Nevada Univ., Reno, NV (USA). Desert Research Inst. May 1989. 42p. Sponsored by Department of Defense. DOE Contract W-7405-ENG-48. Order Number DE89014807/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A thermal gradient diffusion cloud chamber with a supersaturation field which increases along the path of the flow of sample is used as a cloud condensation nucleus (CCN) spectrometer. The CCN spectrum is derived from the final droplet distribution which has been determined to be related to the nucleus critical supersaturation bases on routine calibration procedures using laboratory-produced monodisperse salt particles. The instrument is compared against a previously reported CCN counter on natural laboratory-produced aerosol and against an absolute CN counter on the monodisperse aerosol. Preliminary results of atmospheric measurements are given. This device produces a CCN spectrum over the entire useful range of interest for cloud physics (0.01% to 1% Supersaturation). More than 40 channels of resolution over this range are simultaneously provided. Data can be collected on a continuous basis for integration times as short as 2 seconds. The instrument has obtained data from four different airborne platforms, as well as from a mobile surface platform. The large number of channels allows the CCN spectrum to be displayed differentially instead of the usual cumulative display which is traditionally used in cloud physics. 34 refs., 10 figs., 3 tabs.

34355 **Monitor for gamma radiation at zero degrees from the SLC collision point.** Bonvicini, G. (Michigan Univ., Ann Arbor (USA)); Frey, R.; Gero, E.; Koska, W.; Field, C.; Minten, A. *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment (Netherlands),* 277(2/3): 297-303 (1 May 1989). DOE Contract AC03-76SF00515;AC02-76ER01112.

Bremsstrahlung gamma rays are emitted in a narrow forward cone while the electron and positron beams are being measured with carbon fibers at the SLC (the linear collider at the Stanford Linear Accelerator Center). Beam-beam deflections which occur at the collision point also emit softer gamma rays, called beamstrahlung. A device to detect these gammas is described. It has a converter to produce electron-positron pairs and a gas Cherenkov volume to detect them in the presence of a large, low energy, radiation background. The system is used for beam diagnostics at the SLC.

34356 Method for picosecond lifetime measurements for neutron-rich nuclei. Pt. 2. Timing study with scintillation counters. Moszynski, M. (Brookhaven National Lab., Upton, NY (USA)); Mach, H. *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment (Netherlands)*, 277(2/3): 407-417 (1 May 1989). DOE Contract AC02-79ER10493;AC02-76CH00016.

A delayed coincidence timing system consisting of a thin NE111A plastic scintillator and a BaF_2 crystal coupled to XP2020 and XP2020Q photomultipliers, respectively, and operated in a fast dynode mode was developed. Its performance was otpimized over a dynamic range from 0.3 to 1.6 MeV for γ-rays. For this range a walk of $\pm$22 ps and a time resolution of 96 ps (FWHM) were measured for β-rays with a mean energy of about 600 keV coincident with 1.37 MeV γ-rays from a ^{24}Na source. The high sensitivity of this detector system has been demonstrated by using a β-γ delayed coincidence mode to measure known picosecond lifetimes of nuclear states in neutron-rich nuclei at the TRISTAN fission product mass separator. Mean-lives as short as 51$\pm$3 ps have been measured by the slope method and 10$\pm$7 ps by the centroid shift method. Lifetimes of several nuclear states in ^{142}Ba, ^{142,144}Ce and ^{146}Nd measured by the slope and by the centroid shift method are reported.

34357 Calculation of the pulse-height response of organic scintillators for neutron energies 28<E_n<492 MeV. Sailor, W.C. (Los Alamos National Lab., NM (USA)); Byrd, R.C.; Yariv, Y. *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment (Netherlands)*, 277(2/3): 599-607 (1 May 1989).

An adaptation of the Monte Carlo code of Stanton has been used to calculate the pulse-height spectra for monoenergetic neutrons incident on organic scintillators at energies 28<E_n<492 MeV. Pulse-height distributions calculated with the code are compared to recent experimental results to determine the relative importance of various reaction channels and multiple scattering. The code has also been modified so that the effect of photon losses through attenuation and reflection is modeled for the first time. Changes in the reaction kinematics are discussed which might improve the code's predictive capabilities at neutron energies over 70 MeV.

34358 Fast parallel pipelined readout architecture for a completely flash digitizing system with multilevel trigger. Cousins, R.D. (California Univ., Los Angeles (USA). Dept. of Physics); Konigsberg, J.; Kubic, J.; Melese, P.L.; Hart, G.W.; Molzon, W.R.; Irwin, G.M.; Ouimette, D.A.; Ritchie, J.L.; Trang, Q.H. *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment (Netherlands)*, 277(2/3): 517-531 (1 May 1989).

We have built, and used to take physics data, a digitizing and readout system for Brookhaven AGS Experiment 791, a high-rate search for rare kaon decays. All digitization of charge and time information is 'flash' (performed in less than 200 ns), followed by front-end buffering and a pipelined readout with massive parallelism. A data transfer rate of 0.4 Gbyte/s into dual-port memories in eight 3081-emulating processors has been achieved. A readout-supervising circuit coordinates the three levels of event triggering and the movement of data throughout the system. The host MicroVAX is interrupted only for the uploading of packets of fully filtered events from the 3081/E's. Digitizing and data transfer from the front end to the 3081/E's contribute negligible deadtime to the experiment.

34359 New microcalorimeter concept for photon counting X-ray spectroscopy. Silver, E.H. (Lawrence Livermore National Lab., CA (USA). Lab. for Experimental Astrophysics); Labov, S.E.; Goulding, F.; Madden, N.; Landis, D.; Beeman, J. *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment (Netherlands)*, 277(2/3): 657-663 (1 May 1989). DOE Contract W-7405-ENG-48.

We present an innovative approach for performing photon counting X-ray spectroscopy with cryogenic microcalorimeters. The detector concept takes advantage of the temperature dependence of the dielectric constant in ferroelectric materials. A dielectric calorimeter has many potential advantages over traditional resistive devices, particularly in the reduction of Johnson noise. This makes the energy resolution for photon counting spectroscopy limited only to the noise produced by the intrinsic temperature fluctuations of the device. The detector concept is presented and its predicted performance is compared with resistive calorimeters. Calculations have shown that practical instruments operating with an energy resolution less than 20 eV may be possible at 300 mK.

4402 Radiation Effects On Instrument Components, Instruments, Or Electronic Systems

34360 (SAND–89-0379C) **1/f noise: A nondestructive technique to predict MOS radiation hardness?.** Scofield, J.H.; Doerr, T.P.; Fleetwood, D.M. Sandia National Labs., Albuquerque, NM (USA). 1989. 5p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890723–3: 26. annual conference on nuclear and space radiation effects, Marco Island, Florida, USA, 24-28 Jul 1989). Order Number DE89007419/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We find a strong correlation between the preirradiation 1/f noise of pMOS transistors and their radiation hardness. This suggests that current fluctuations may provide a useful, nondestructive probe of defects in MOS devices. 18 refs., 4 figs., 1 tab.

4403 Miscellaneous Instruments

Refer also to citation(s) 33154, 33489, 34150, 34163, 34219, 34370, 35444, 35445

34361 (AD-A–201331/6/XAB) **Integration of detectors and optical-waveguide structures. Final report, 15 March 1985-15 March 1988.** Boyd, J.T. Cincinnati Univ., OH (USA). Dept. of Electrical and Computer Engineering. 15 Sep 1988. 28p. Available from NTIS, PC A03/MF A01.

Integrated detection of light propagating in an optical waveguide with a photodetector array fabricated directly on the waveguide surface was demonstrated. Devices having very good performance were formed by depositing polycrystalline silicon and laser recrystallizing it prior to device fabrication. The use of two lasers was shown to result in improved recrystallization. Analysis of a four-layer optical waveguide structure was performed and applied to multiple layer gallium-aluminum-arsenide structures and SiO_2/Si structures. Numerical calculations of waveguide attenuation due to substrate coupling for thermally-nitrided silicon dioxide and for gallium aluminum arsenide waveguides were performed for a variety of layer thicknesses, layer-material compositions, and wavelengths. Comparison with some experimental data was carried out. Extensive Raman microprobe characterization was also performed on laser-recrystallized silicon and on GaAlAs dielectric strip waveguide structures. use of rapid thermal annealing to initiate in-diffusion of Ti into $LiNb0_3$ has yielded low-loss optical waveguides.

34362 (DOE/MC/22184–2661) **Particle sizing experiments with the laser Doppler velocimeter: Final report.** Giel, T.V. Jr.; Son, J.Y. Tennessee Univ., Tullahoma, TN (USA). Space Inst. Jun 1988. 78p. Sponsored by DOE Fossil Energy. DOE Contract AC21-85MC22184. Order Number DE89000910/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

Measurement techniques for in-situ simultaneous measurements of particle size distributions and particle velocities using the dual beam laser Doppler velocimeter (LV) were analytically and experimentally investigated. This investigation examined the different signal characteristics of the LV for determination of particle size and particle velocity, simultaneously. The different size related signal components were evaluated not only singularly but also as simultaneous measurements to determine which characteristic, or combination of characteristics, provided the best measure of particle size. The evaluation concentrated on the 0.5 to 5 μm particle size range, in which the LV light scattering characteristics are complex often non-monotonic functions of the particle size as well as functions of index of refraction, the laser light wavelength, laser intensity and polarization, and the location and response characteristics of the detector. Different components of the LV signal were considered, but analysis concentrated on Doppler phase, visibility and scatter-intensity because they show the greatest promise. These signals characteristics were initially defined analytically for numerous optical configurations over the 0.5 to 5 μm diameter range with

0.1 μm segmentation, for refractive index values from 1.0 to 3.0 with absorptive (imaginary) components varied form 0 to 1.0. Collector orientation and effective f/No., as well as fringe spacing, beam polarization and wavelength, were varied in this analytical evaluation. 18 refs., 42 figs., 5 tabs.

34363 (JINR–13-88-589) **Ion detector on the basis of microchannel plates for a high-sensitive mass spectrometer.** Rodin, A.M.; Sidorchuk, S.I.; Timakov, V.A. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions. 1988. 8p. (In Russian). Order Number DE89620335/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

The parameters of low energy ion detector designed as tandem type microchannel plates (MCP) are measured. The measurements were performed both in the current mode and in the mode of single ion count. It is shown that using of the detector designed as tandem type MCP allows one to measure the pulsed ion flows in the range from 10^{14} $cm^{-2}xs^{-1}$ to 10^{-2} $cm^{-2}xs^{-1}$. 6 refs.; 5 figs.; 1 tab.

34364 (JINR-R–10-88-381) **CAMAC crate controller KK009 for the Pravetz-16 and IBM PC/XT personal computers.** Georgiev, A.; Churin, I.N. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems. 1988. 12p. (In Russian). Order Number DE89620334/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A CAMAC crate controller and a computer bus adapter for the Pravetz 16 and IBM PC/XT personal computers are described. The following features are included in the controller: operation under program control; access to CAMAC registers treated as memory locations corresponding to given N, A, F; hardware for fast LAM processing and execution of multi-crate commands; device up to 7 crates in one CAMAC system; built-in hardware for controller and crate dataway test. 4 refs.; 3 figs.; 9 tabs.

34365 (LBL–27040) **X-ray holography: A history.** Jacobsen, C. Lawrence Berkeley Lab., CA (USA). Apr 1989. 13p. Sponsored by DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-8808233–1: Conference on X-ray microscopy in biology and medicine, Tochigi, Japan, 25-27 Aug 1988). Order Number DE89012983/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

X-ray holographic microscopy has recently reached a milestone in its development by producing images of biological specimens at sub-micron resolution. However, x-ray holography is by no means a new subject, and it is the purpose of this article to review the history of experimental activity in this field (theoretical activities will also be mentioned). 75 refs., 2 figs.

34366 (SAND–89-0589C) **Novel applications of the field ion microscope and atom-probe.** Kellogg, G.L. Sandia National Labs., Albuquerque, NM (USA). 1989. 24p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890748–4: Microbeam Analysis Society meeting, Asheville, North Carolina, USA, 16-21 Jul 1989). Order Number DE89008684/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Introduced in 1951 and 1966 respectively, the field ion microscope and atom-probe mass spectrometer can hardly be considered new or emerging microprobes. Over the years, the ability to use these instruments to examine the structure and composition of various materials at the atomic level has been well established. However,recent advances in more conventional microanalytical techniques, particularly progress toward a higher degree of spatial resolution, has created renewed interest in all techniques capable of analysis on a very fine scale. Also, there has been an increased emphasis over the past several years in the application of the field ion microscope and atom-probe to problems of greater general interest in surface and materials science. It is therefore not totally inappropriate to discuss the field ion microscope and atom-probe within the context of "emerging" microprobes. The intent of this paper is to familiarize the reader with the techniques of field ion microscopy and atom-probe mass spectroscopy and describe several recent applications which demonstrate some of their unique attributes. 45 refs., 8 figs.

34367 **Interferometry of full spheres.** Lawrence, G.N. (Los Alamos National Lab., Los Alamos, NM (US)); Day, R.D. v.v of Current developments in optical engineering II. Fischer, R.E.; Smith, W.J. SPIE Society of Photo-Optical Instrumentation Engineers, Bellingham, WA (1987). (CONF-8708232–: Current developments in optical engineering II, San Diego, California, USA, 18-21 Aug 1987).

This report describes recent research in application of interferometry to measurement of the aberrations of full spheres using an extension of subaperture testing theory. Theoretical and numerical studies have substantiated the method. Experimental validation has been done by comparison with mechanical roundness traces. Direct comparison is impossible because both methods suffer from misalignment errors. In this paper, a data reduction technique is developed for the mechanical roundness traces and comparison is made of the reduced data from both methods.

34368 **Thermal lens measurements in liquids on a submicrosecond time scale.** Isak, S. J. (Department of Chemistry, University of Utah, Salt Lake City, Utah 84112(US)); Komorowski, S. J.; Merrow, C. N.; Poston, P. E.; Eyring, E. M. *Applied Spectroscopy (USA),* 43(3): 419-421 (Mar 1989).

The use of the thermal lens method is shown to be quite suitable for kinetic studies of quenching on a submicrosecond time scale. The lower limit of time resolution that can be achieved is determined by the acoustic transit time, τ_a, in the medium. A thermal lens signal with a 100-ns time constant due to the quenched triplet state of benzophenone is readily measured. The thermal lens method is superior to the photoacoustic (PA) method in the breadth of the accessible time range, and in the significantly fewer measurements required to obtain accurate data, including no requirement for a reference sample; it is also less sensitive to geometrical and laser power requirements than is the PA method.

4404 Well Logging Instrumentation

Refer also to citation(s) 35067

45 EXPLOSIONS AND EXPLOSIVES

4501 Chemical

34369 (SAND–88-0930) **Characterization of Morton-Thiokol booster-rocket propellant TP-H1207C and its simulant H-19.** Weirick, L.J.; Dugan, D.W. Sandia National Labs., Albuquerque, NM (USA). May 1989. 49p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. Order Number DE89013347/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A series of experiments on a propellant and its simulant have recently been completed on a light-gas gun. The intent of this work is to characterize the shock sensitivity of booster-rocket propellants and their simulants. The initial objectives are to obtain Hugoniot data, to investigate the pressure threshold at which a reaction occurs, and to measure spall damage at various impact velocities. The Hugoniot data obtained for the propellant fits the Hugoniot curve provided by the manufacturer of the propellant extremely well. The Hugoniot curve developed for the simulant was found to match that of the propellant very well. The density, initial bulk sound velocity, and empirical parameter S values for the composite propellant, TP-H1207C, are 1.84 g/cm^3, 2.3 mm/μs, and 2.16, respectively; for its simulant, H-19, they are 1.89 g/cm^3, 2.25 mm/μs, and 1.5, respectively. The ignition threshold pressure of the TP-H1207C was found to be in the range of 40 kbar. Violent reactions were observed at impact pressures of 50 kbar. The propellant exhibited spall strengths around 0.25 kbar, with its simulant being somewhat weaker, 0.18 kbar. 18 refs., 25 figs., 6 tabs.

34370 (SAND–88-3239C) **Evaluation of the Oak Ridge MS/MS explosives detector.** Conrad, F.J.; Hannum, D.W.; Grant, B.C.; McLuckey, S.A.; McKown, H.S.; Glish, G.L. Sandia National Labs., Albuquerque, NM (USA). 1989. 20p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890769–1: 3. international symposium on analysis and detection of explosives, Mannheim, Germany, F.R., 10-13 Jul 1989). Order Number

DE89010771/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Results are presented for the evaluation of the Oak Ridge National Lab (ORNL) MS/MS as an explosives detector. This instrument is a beam instrument containing a quadrupole and a time-of-flight detector section (QTOF). The tests include a Limit of Detection for the instrument, an interferent study, a test of personnel sampling for explosives, a test involving mail sampling, and detection tests with bomb quantity explosives. 3 refs., 5 figs., 1 tab.

34371 (SAND–89-0090C) **Detonation of unconfined large scale fuel spray-air clouds.** Benedick, W.B.; Lee, J.H.; Knystautas, R. Sandia National Labs., Albuquerque, NM (USA). 1989. 21p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890739–1: 12. international colloquium on the dynamics of explosions and reactive systems, Ann Arbor, Michigan, USA, 23-28 Jul 1989). Order Number DE89006510/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Unconfined heterogeneous two-phase detonations in liquid droplet-air mixtures are investigated. The liquid fuel is placed in a V-shaped channel and is dispersed into the atmosphere to form a cloud by an explosive detonating cord laid along the bottom vertex of the channel. An aerosol cloud 7 m high by about 1.5 m averaged width can be generated in this way with a typical mass ratio of fuel to explosive charge of 150. In the present study the length of channel used is typically 10 m giving a detonable fuel-air cloud of about 100 m^3. The propylene-oxide driver and the test fuel are disseminated simultaneously. Detonation in the propylene-oxide section is initiated by the sheet explosive and the detonation then transmits from this driver section into the rest of the cloud formed from the test fuel. For insensitive fuels requiring a larger cloud dimension, two parallel fuel troughs spaced 1.2 m apart are used. It is found that propylene-oxide and nitrated hydrocarbon fuels detonate quite readily. For the case of propylene-oxide, significant vaporization of the aerosol is observed prior to initiation so that detonation is essentially in the gas phase. 15 refs., 4 figs.

34372 (UCRL–98864-Rev.) **Thin pulse shock initiation characterization of extrusion-cast explosives: Revision.** Bloom, G.; Lee, R.; Von Holle, W. Lawrence Livermore National Lab., CA (USA). 1989. 10p. Sponsored by DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-890661–6-Rev.: 3. international symposium on behavior of media under high dynamic pressures, La Grande Motte, France, 5-9 Jun 1989). Order Number DE89008029/JAW. Available from OSTI; GPO Dep.

We have used an electric gun to measure detonation thresholds of two voidless HMX-based extrusion-cast explosives (ECX) for various pulse widths and flyer diameters. Thin-pulse shock-initiation thresholds were measured using a 56 μF, 40-kV capacitor bank to explode aluminum foils that drive polyester (Mylar) or polycarbonate (Lexan) flyers of various thicknesses and diameters. We compare the results with those for the HMX-based PBX-9404, which contains 2% voids. For various pulse widths the ECXs are less sensitive, particularly for longer pulse lengths. The ECXs are less sensitive for larger flyer diameters and the same sensitivity for the smallest diameter flyers. 8 refs., 5 figs., 2 tabs.

4502 Nuclear

Refer also to citation(s) 33800, 33803

34373 (AD-A–201247/4/XAB) **Review of DNA(Defense Nuclear Agency) Remote Security Station (RSS) Project. Phase 1.** Pietta, J.B.; Workhoven, R.M. Sandberg-Serrell Corp., Pasadena, CA (USA). Aug 1988. 86p. (SAND–88-1230). Available from NTIS, PC A05/MF A01.

This report reviews the progress made during FY87 on the Defense Nuclear Agency (DNA) sponsored Remote Security Station (RSS). During this time frame, Sandia National Laboratories was tasked to develop a Phase 1 proof-of-principle system consisting of readily available hardware. The primary emphasis was placed upon development of software and sensor fusion techniques and, as a result, the Phase 1 hardware is not suitable for field deployment. The RSS consists of a portable (non-mobile) sensor platform and an intelligent controller. The paper includes descriptions of the sensor platform and control console hardware, as well as the software that runs the intelligent controller. The sensor fusion techniques originally considered are discussed, and the methods used in the current system are explained in detail. Phase 2 development of the RSS is scheduled for FY88, and a discussion of the planned improvements is included.

34374 (NVO–329) **Weather predictions and surface radiation estimates for Project CABRIOLET.** National Oceanic and Atmospheric Administration, Las Vegas, NV (USA). Weather Service Nuclear Support Office. May 1989. 69p. Sponsored by DOE Defense Programs. DOE Contract AI08-87NV10566. (PNE–961). Order Number DE89014685/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

This report documents the activities of the Air Resources Laboratory-Las Vegas (ARL-LV) in support to Project CABRIOLET. The participation of ARL-LV in the Safety Program is stressed, but the full scope of objectives and functions is covered. A description is given of observational facilities used to provide weather services. Weather and fallout predictions issued for the project, as well as prediction procedures and techniques are discussed. A comparison of predicted and observed weather and fallout is made. The results of these activities will serve as a basis for planning and participating in future projects.

34375 (NVO–330) **Weather predictions and surface radiation estimates for Project Palanquin: Final report.** National Oceanic and Atmospheric Administration, Las Vegas, NV (USA). Weather Service Nuclear Support Office. May 1989. 41p. Sponsored by DOE Defense Programs. DOE Contract AI08-87NV10566. (PNE–912F). Order Number DE89013797/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The Environmental Science Services Administration Field Research Office (ESSA/FRO) provided weather planning and prediction for the Safety Program of the Palanquin Event. Observations of winds and weather conditions began prior to the event and the weather and radioactivity forecasting service commenced on April 7, the initial ready date. During the following week, the winds and weather conditions were sufficiently abnormal that the planned firing criteria were not met, resulting in delays. Acceptable weather occurred on April 14, and all meteorological criteria were met. Trajectories followed reasonably close to predictions, but exposure levels exceeded predictions. 1 ref., 14 figs., 1 tab.

34376 (NVO–331) **Weather predictions and surface radiation estimates for Project SCHOONER.** National Oceanic and Atmospheric Administration, Las Vegas, NV (USA). Weather Service Nuclear Support Office. May 1989. 67p. Sponsored by DOE Defense Programs. DOE Contract AI08-87NV10566. (PNE–523). Order Number DE89014686/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

This report documents the activities of the Air Resources Laboratory-Las Vegas (ARL-LV) in support of Project SCHOONER. The participation of ARL-LV in Safety Program is stressed, but the full scope of objectives and functions is covered. A description is given of observational facilities used to provide weather services. Weather predictions and fallout estimates issued for the project as well as procedures and techniques are discussed. A comparison of predicted and observed weather and fallout is made. The results of these activities will serve as a basis for planning and participating in future projects. 2 refs., 17 figs.

34377 (NVO–332) **Weather predictions and surface radiation estimates for Project BUGGY I.** National Oceanic and Atmospheric Administration, Las Vegas, NV (USA). Weather Service Nuclear Support Office. May 1989. 70p. Sponsored by DOE Defense Programs. DOE Contract AI08-87NV10566. (PNE–328). Order Number DE89014687/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

This report documents the activities of the Air Resources Laboratory-Las Vegas (ARL-LV) in support of Project BUGGY I. The participation of ARL-LV in the Safety Program is stressed, but the full scope of objectives and functions is covered. A description is given of observational facilities used to provide weather services. Weather predictions and fallout estimates issued for the project, as well as procedures and techniques, are discussed. A comparison of

predicted and observed weather and fallout is made. The results of these activities will serve as a basis for planning and participating in future projects. 2 refs., 24 figs.

34378 (UCRL–100429) **Effect of material strength models in the formation dynamics of a three-dimensional explosively formed penetrator: Comparison of calculations with experiment.** Baum, D.W.; Honodel, C.A.; Schneider, D.P. Lawrence Livermore National Lab., CA (USA). Apr 1989. 12p. Sponsored by DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-890585–5: 11. international symposium on ballistics, Brussels, Belgium, 9-11 May 1989). Order Number DE89013789/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Three-dimensional calculations were performed to examine the role of material-strength models in predicting the formation of a tantalum nonaxisymmetric explosively formed penetrator. We compared calculations of the shape of the liner as a function of time with radiographic images of it. We used three different constitutive models of tantalum, including the standard Steinberg-Guinan high-rate model, a modified half-strength Steinberg-Guinan model, and a new, rate-dependent Steinberg-Guinan-Lund model. Instrumentation for the experiments included a 100-MeV linac, multiple 450-kV pulsed radiographs, and high-speed cameras. Radiographs of the liner were obtained at times of 22, 100, 150, and 380 μs after explosive initiation. A direct comparison of the calculated liner shapes at these times shows that the liner shape is sensitive to the material-strength model throughout its development, and the rate-dependent model agrees best with the experiment over the complete formation time of the liner. 4 refs., 9 figs.

50 ENVIRONMENTAL SCIENCES, ATMOSPHERIC

5001 Basic Studies

Refer also to citation(s) 33710, 34375

34379 (DOE/PC/79668–T3) **Conceptual design of a coal-fired MHD retrofit plant: Quarterly report for January 1989–March 1989.** Bibber, L.E.; Wiseman, D.A.; Muenchow, H.O.; Holman, R.R.; Bernard, F.E. Westinghouse Electric Corp., Pittsburgh, PA (USA). Advanced Energy Systems Div. Jun 1989. 22p. Sponsored by DOE Fossil Energy. DOE Contract AC22-87PC79668. Order Number DE89012706/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The objective of the project is to prepare a site-specific conceptual design of a coal-fired magnetohydrodynamic (MHD) system for retrofit to the Scholz Generating Station, Sneads, Florida. The MHD System includes a topping cycle and bottoming cycle but no integrated seed regeneration system. Provisions for future integration of a seed regeneration system will be made with respect to location at the utility site, waste heat utilization, and materials handling. The conceptual design shall include: process, system, and equipment descriptions, interface identification and requirements, equipment and handling arrangements, an overall plant layout, cost and schedule for the design, fabrication/procurement, and arrangement of each major component, and a critical path for the total system effort. The conceptual design will be in sufficient detail to ensure that the integration of the MHD System with the Scholz Generating Station will be compatible with the utility industry standards for constructibility, operability, reliability, and maintainability. 2 tabs.

34380 (UCRL–21153) **Water nucleation properties of chaparral fire aerosol particles.** Hudson, J.G.; Rogers, C.F.; Hallett, J. Lawrence Livermore National Lab., CA (USA). May 1989. 15p. Sponsored by Department of Defense. DOE Contract W-7405-ENG-48. Order Number DE89013711/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

In December, 1986, planned and prescribed forest management burns took place at Lodi Canyon, on the north side of the Los Angeles Basin, California. These fires involved a mixture of species of small trees and shrubs, including scrub oak, chamise, and mountain mahogany, known collectively as "chaparral" in the Western US. Over a period of about two weeks, about 200 hectares of chaparral were consumed. This prescribed burn presented an opportunity for three days of airborne measurements of aerosol properties including total particle or condensation nuclei (CN) concentrations and cloud condensation nuclei (CCN) concentrations. This study is in coordination with other efforts conducted simultaneously; here the emphasis will be on the airborne CN and CCN measurements and on related studies conducted on a laboratory scale. In this study, we distinguish between CCN and the total aerosol particle population as gauged by the CN count. CCN and CN concentrations and CCN/CN ratios will be presented for the airborne measurements and for laboratory measurements employing a similar fuel. Ancillary ion chromatography (IC) and scanning electron microscopy (SEM) information will also be presented for the laboratory-scale chaparral burn. 11 refs., 4 figs., 4 tabs.

5002 Chemicals Monitoring and Transport

Refer also to citation(s) 33125, 33131, 33145, 33724, 33732, 33733, 34027, 34103, 34223, 34374, 34464, 34495

34381 (BNL–39845) **Estimates of historic urban air quality trends and precipitation acidity in selected US cities (1880-1980).** Lipfert, F.W. Brookhaven National Lab., Upton, NY (USA). Oct 1987. 39p. DOE Contract AC02-76CH00016. Order Number DE89014681/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Estimates for historical urban acidic deposition trends are presented for the past 100 years for twenty Northeastern US cities, which were selected because of the presence of significant historic buildings and monuments. Estimates are made for both local SO_2 concentrations (dry deposition) and the approximate onset of acidic precipitation in the urban areas. SO_2 estimates are based on housing density, space heating fuel use, and the state level ratios of other area source SO_2 emissions to space heating emissions, and are seen to compare reasonably well with the available measurements. These estimates show that urban SO_2 concentrations generally peaked in the period 1920-1950, after the advent of widespread use of natural gas in midwestern cities resulted in large air quality improvements. However, the use of residual fuel oil in Eastern seaboard cities delayed improvements in sulfur air quality there until the late 1960's. Peak annual average SO_2 concentrations were estimated to have exceeded 500 ug/m^3 (0.2 ppM) in New York City, Chicago, and Cleveland. Precipitation acidity estimates are based on the trade-off between urban SO_2 (acidifying) and non sulfate particulates (neutralizing) using relationships developed from contemporary data in six US cities. This trade-off implies that precipitation is likely to have become acidified in most Northeastern medium sized and smaller cities since 1950; Chicago and New York were likely to have had acidic precipitation during all time periods for which measured air quality data are available (since the 1930's). Possible nitric acid effects on material damage are not included in these estimates but are believed to have become of potential importance only in the last few decades, following the rise in NO_x emissions. 36 refs., 11 figs., 3 tabs.

34382 (DOE/ER–0411) **Atmospheric carbon dioxide and the greenhouse effect.** Firestine, M.W. (ed.). USDOE Office of Energy Research, Washington, DC (USA). Office of Basic Energy Sciences. May 1989. 36p. Sponsored by DOE Energy Research. Order Number DE89012869/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This document contains a non-technical review of the problems associated with atmospheric carbon dioxide and the resulting greenhouse effect. (TEM)

34383 (DOE/ER/30107–T1) **National Acid Precipitation Assessment Program annual report, 1987.** National Acid Precipitation Assessment Program, Washington, DC (USA). Office of the Director. Apr 1988. 76p. Sponsored by DOE/ER;OGA. DOE Contract AI01-87ER30107. Order Number DE89012964/JAW. Available from NTIS, PC A04/MF A01 - GPO - OSTI; GPO Dep.

This report describes the research accomplishments of the National Acid Precipitation Program (NAPAP) during fiscal year 1987. The report supplements the NAPAP Interim Assessment as a summary of recent developments in the state of science as it pertains to

the formation, transport, deposition, and effects of acidic and oxidant substances in the atmosphere. The research and monitoring activities of the National Program have been designed and conducted to rapidly advance the scientific basis for assessment activities and to provide the rational foundations for environmental policy as it relates to acidic deposition. As the Interim Assessment and five previous Annual Reports illustrate, the program has already produced an extensive body of research findings. Over the course of the next two years, the National Program will work with states, the private sector, and the domestic and international scientific communities to elaborate its research findings in an integrated assessment of the causes and effects of acidic deposition. The past year has been especially active for the National Program because of the completion of the Interim Assessment and the conduct of ongoing research efforts. Work on the Assessment accelerated the examination of results of programs completed thus far. The Interim Assessment provides a foundation for organizing future research, and a vehicle to focus activity on those areas where a lack of understanding presently limits the credibility of predictions and extrapolations.

34384 (ESC-WR–89-07) **The greenhouse effect. Uncertainty dilemma between science and policy and its effect on scenario development.** Okken, P.A.; Rotmans, J.; Swart, R.J. Stichting Energieonderzoek Centrum Nederland, Petten (Netherlands). Energie Studie Centrum. Apr 1989. 11p. Available from Netherlands Energy Research Foundation ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

Paper presented at IEA/IPCC expert group meeting on methodologies and analytical tools, Paris, France, 10-11 April 1989.

The problems of climate change is unprecedented in energy policy development. It may be necessary to take economically unattractive measures to avoid possible grave environmental impacts. Although these impacts are not yet obvious, when they become visible, delay times in geophysical and socio-economical responses will probably make measures late and ineffective. An overview is given of some of the most important uncertainties involved. Different approaches to energy scenario development will be discussed in view of climate change, followed by an example of a combined approach. Finally, some conclusions will be drawn. 5 figs., 4 refs., 3 tabs.

34385 (KTM/E-D–165) **Nitrous oxide emissions from stationary sources.** Hellen, G. Kauppa-ja Teollisuusministerio, Helsinki (Finland). Energiaosasto. 1989. 47p. (In Finnish). Order Number DE89776161/JAW. Available from NTIS (US Sales Only), PC A03/MF A01;1.

Research studies have identified N_2O as a trace gas potentially contributing to stratospheric ozone depletion as well as being a contributor to global climate change through the greenhouse effect. The atmospheric concentration of nitrous oxide is increasing steadily at a rate of approximately 0.25 per cent per year. Thus there are substantial reasons for concern, but may aspects of the N_2O problem are poorly understood. The emission of nitrous oxide from stationary sources has been suggested to represent an important source flux. This report summerizes the current understanding of combustion generated N_2O emissions, N_2O measurement techniques, N_2O formation/destruction mechanisms and control approaches. The report presents also the results from N_2O emission measurements from different kinds of stationary combustion sources in Finland. The investigation included twenty combustion plants, representing different dimensions and burning techniques (burners, stationary and circulation fluidized beds, grates). The fuels used were oil, coal, natural gas, peat and wood chips. The measurement procedure used was laminate bags for sampling and GC-MS-method for analysis.

34386 (PB–89-135099/XAB) **National Acid Precipitation Assessment Program annual report 1987 to the President and Congress.** National Acid Precipitation Assessment Program, Washington, DC (USA). Apr 1988. 81p. Available from NTIS, PC A05/MF A01.

See also report for 1986, PB–88-138037.

The document reports on 1987 research activities of the National Acid Precipitation Assessment Program (NAPAP). It outlines 1987 research highlights, future research activities, major deliverables, and the program's 1990 research objectives. Its seven substantive chapters cover NAPAP research in the areas of: Emissions and controls; Atmospheric chemistry; Atmospheric modeling and transport; Atmospheric deposition and air-quality monitoring; Terrestrial effects (on forests and crops); Aquatic effects; and Effects on materials and cultural resources. The document includes introductory materials on the National Program's organizational structure, efforts at research coordination, peer and program review activities, and budget. A complete listing of the program's 1987 publications is also included.

34387 (PB–89-137012/XAB) **Control technology assessment of hazardous-waste-disposal operations in chemicals manufacturing: in-depth survey report of San Juan Cement Company, Dorado, Puerto Rico, November 1981.** Crandall, M.S. National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Jul 1982. 36p. (ECTB–103-21A). Available from NTIS, PC A03/MF A01.

See also PB–84-226935.

A visit was made to the San Juan Cement Company, Dorado, Puerto Rico to evaluate control methods for a storage and delivery system for hazardous wastes used in a demonstration project as a supplemental fuel for cofiring a cement kiln. Analysis of the material during the visit revealed the presence of methylene chloride, carbon-tetrachloride, chloroform, acetone, hexane, ethanol, and ethyl acetate. Steel storage tanks were placed on an impermeable concrete slab surrounded by a sealed retaining wall. Steel piping with all welded joints carried the waste fuels from storage tanks to the kiln, where fuels were injected through a specially fabricated burner. Vapor emissions were suppressed by venting the displaced vapor through a recycle line. Exhaust gases from the kiln passed through a bag house type dust collector, and were vented to the atmosphere through a single stack. Half-mask air-purifying respirators were used when in the hazardous-waste storage/delivery area. Neoprene gloves were used when performing tasks with potential skin contact. Hard hats, safety glasses, and safety boots were all worn. The author concludes that the control methods used seemed effective in suppressing vapor emissions.

34388 (PB–89-137020/XAB) **In-depth survey report: control technology assessment of unit operations employed in oral-contraceptive tablet-making operations at Ortho Pharmaceutical Corporation, Raritan, New Jersey, June 13-17, 1983.** Anastas, M.Y.; Caplan, P.E.; Froehlich, P.A. National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Nov 1983. 49p. (ECTB–105-13A). Available from NTIS, PC A03/MF A01.

See also PB–82-152281.

An on-site visit was made to the Ortho Pharmaceutical Corporation (OPC), Raritan, New Jersey to evaluate methods of controlling exposure to hazardous materials during the manufacturing of medications. OPC produced oral-contraceptive tablets containing norethindrone (NOR), mestranol, and ethynylestradiol (EE). Ventilation was an important engineering control at this site. Other engineering controls included the isolation of work procedures and automation of work practices for weighing ingredients, granulation of substances, tableting, and packaging. Area samples were taken for air monitoring of steroid concentration levels in each manufacturing area. Access to the work areas was only through the locker rooms. Samples taken in the locker rooms revealed no detectable contaminant levels. Workers performing high risk activities wore air supplied vinyl suits and disposable rubber gloves. The vinyl suits had overshoes attached. For moderate risk activities the workers wore a disposable suit, rubber gloves and shoe covers. Appropriate respirators were provided. Workers in low risk activities wore disposable rubber gloves and appropriate respirators. Sampling indicated that processing workers experienced breathing-zone levels outside their vinyl suits of 16.40 and 0.36 micrograms/cubic meter of NOR and EE, respectively.

34389 (PB–89-137038/XAB) **Preliminary survey report: Plating Shop, Braniff Airways, Love Field, Dallas, Texas, June 29, 1981.** Mortimer, V.D. National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). 14 Oct 1981. 8p. (ECTB–106-16A). Available from NTIS, PC A02/MF A01.

An on-site visit was made to the Plating Shop of Braniff Airways, Dallas, Texas to evaluate control methods used to protect workers from hazards arising during electroplating processes. Some of these hazards included exposures to cyanide, various acid mists, and toxic metals such as chromium. The plating shop was a separate room within a building, occupying about 4000 square feet of the area with a 20-foot ceiling height. The shop was well painted and

maintained with concrete floors covered with wood slated platforms around the tanks. Local exhaust ventilation was installed on the three hard chrome tanks and some of the pretreatment tanks. There were three cadmium tanks and other tanks including nickel, nickel strike, silver, silver strike, copper, certain acids, rinses, strippers, cleaners and a vapor degreaser. Gloves were worn when removing pieces from the acid dip and plating tanks. Workers wore face shields when working around the nitric acid tank. No evaluation of the chrome-plating control method could be made because no chrome plating was occurring during this visit. The author concludes that if sufficient plating workload were available for 3 full work days, this facility would be a strong candidate for an in-depth study.

34390 (PB–89-137046/XAB) **Preliminary survey report: Plating Shop, American Airlines, Maintenance and Engineering Center, Tulsa International Airport, Tulsa, Oklahoma, July 1, 1981.** Mortimer, V.D. National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). 3 Dec 1981. 7p. (ECTB–106-17A). Available from NTIS, PC A02/MF A01.

A visit was made to the Plating Shop of the American Airlines Maintenance and Engineering Center, Tulsa, Oklahoma in order to evaluate control methods in place at this facility. The plating shop was a separate room within a larger building. The tanks were set on concrete pedestals built up from the concrete ventilation duct tunnels which run underneath each line. Grit blasting and shot peening were performed in another area. There were three hard chrome lines with a total of 22 plating tanks. One line contained electroless nickel and copper plating tanks, and the cadmium for the nickel/cadmium process. There was a nickel line with four plating tanks and a cadmium line. Twenty-eight workers were employed at the time of this visit in the plating shop including two machinists. Work practices includes draining and rinsing pieces over the plating tanks. Gloves were worn when removing pieces from the acid dip and plating tanks, and the workers wore face shields when working around the nitric acid tank. The author concludes that the ventilation system worked exceptionally well. The author recommends that this facility be included in an in-depth evaluation of safety and control measures in the plating industry.

34391 (PB–89-137152/XAB) **In-depth survey report: control technology for ethylene oxide sterilization in hospitals at Bronson Methodist Hospital, Kalamazoo, Michigan. Report for 25 February-1 March 1985.** Mortimer, V.D.; Kercher, S.L. National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Nov 1985. 37p. (ECTB–146-13B). Available from NTIS, PC A03/MF A01.

See also PB–85-222164.

A visit was made to Bronson Methodist Hospital, Kalamazoo, Michigan to evaluate methods used to protect workers from exposures to ethylene oxide (EtO). Possible drain exposure was controlled by isolating all of the sterilizer unit except for the front panel, into a ventilated recess room. Charcoal-tube measurements indicated the facility had achieved excellent control of the full shift exposures with all values obtained being less than 0.2 parts per million (ppm). While exposures for to the sterilizer operators were low, it would be possible to reduce them even more by removing some of the impediments to the load transfer process. Rehinging the doors of the aerator to the other side would enable a smoother transfer to be made. Levels in the recess room were 100ppm near the drain, and this room must be avoided during purging and for some time following purging. However, no warnings were posted and the authors recommend that this hazardous situation be corrected. The drain exhaust should be added to the auxiliary exhaust system. A differential pressure sensor should be installed on the auxiliary ventilation system and an emergency evacuation and response plan be developed and rehearsed. Face shields and gloves should be required to protect the maintenance worker who changes the supply canisters of EtO.

34392 (PB–89-137285/XAB) **Mercury control technology assessment study: General Electric Ccompany, Circleville Lamp Plant, Circleville, Ohio. Preliminary survey report for the site visit of October 6, 1981. Final report.** Telesca, D.R. Dynamac Corp., Rockville, MD (USA). Enviro Control Div. 19 Feb 1982. 24p. Available from NTIS, PC A03/MF A01.

A visit was made to the General Electric Company's Circleville Lamp Facility, Circleville, Ohio for the purpose of evaluating control methods designed to protect the workers from exposure to hazardous levels of mercury. The visit included a review of the fluorescent-lamp manufacturing process, a tour of the production facility, and an investigation of engineering controls, work practices and monitoring programs. Existing control strategies appeared effective in maintaining mercury vapor levels below the OSHA standard of 0.10mg/m^3. This was achieved through a combined effort in providing extensive dilution ventilation, modifying process equipment for mercury control, and developing the proper work practices for handling mercury. Areas suggested for further research as a result of this visit include the development of a small portable vacuum cleaner which would be effective in safely cleaning mercury spills, developing a procedure to reprocess mercury laden oil, and developing a comfortable and lightweight powered air-purifying helmet for respiratory protection against exposure to mercury vapor.

34393 (PB–89-137301/XAB) **Mercury control technology assessment study: GTE Products Corporation, Chemical and Metallurgical Division, Towanda, Pennsylvania. Preliminary survey report for the site visit of June 9, 1981. Final report.** Telesca, D.R. Dynamac Corp., Rockville, MD (USA). Enviro Control Div. 25 Jun 1982. 21p. Available from NTIS, PC A03/MF A01.

A visit was made to GTE Products Corporation, Chemical and Metallurgical Division, Towanda, Pennsylvania to evaluate mercury control methods. The company manufactured chemical, metal, and ceramic products; tungsten bar pressing and treating required the use of mercury. Ten workers had potential mercury exposure during this typical tungsten-sintering activity. Mercury was used as a continuous electrical contact in the sintering process and was contained in pools called mercury cups. Each sintering unit was located in a ventilated enclosure. The ventilation system, air-supply, and air-exhaust systems are described. Personal protective equipment included sheepskin gloves, Tyvek disposable smocks, and air-line respirators. Work practices were delineated. Biological monitoring included monthly urinalysis for mercury. Workers with urine mercury level exceeding 0.10 milligrams/liter were removed to another area of the facility. Air-contaminant monitoring was not routinely performed at this site. The authors conclude that existing control strategies associated with the manufacture of tungsten rods may be effective in controlling exposures to mercury. It is recommended that the facility adopt a regular air-monitoring program to determine levels of mercury in ambient air.

34394 (PB–89-137319/XAB) **Mercury control technology assessment study: Micro Switch, a Honeywell Division, Freeport, Illinois. Preliminary survey report for the site visit of May 5, 1981. Final report.** Telesca, D.R. Dynamac Corp., Rockville, MD (USA). Enviro Control Div. 10 Nov 1981. 24p. Available from NTIS, PC A03/MF A01.

A visit was made to the Micro Switch Division of Honeywell, Freeport, Illinois to investigate the effectiveness of control methods for mercury. There were 150 workers employed in the mercury-switch department. Of the eight rooms involved in this department, the press seal room, the fill room, and the room where adjusting and leading were accomplished were the areas where mercury exposure was most likely. Engineering controls in the mercury fill room included the placement of an air-supply and air-exhaust system. Personal protective equipment in use at the site included disposable Tyvek smocks which were changed weekly, latex disposable gloves which were changed daily, disposable respirators, and shoes used exclusively for work. Work practices were designed to avoid mercury contact. Preemployment and routine ongoing urinalyses were conducted; when mercury levels in the urine exceeded 0.05 milligrams/liter, the worker was taken out of the mercury exposure areas. Mercury was detected in all air samples taken with the highest sample concentration being 0.052mg/m^3. The facility is recommended for an in-depth survey when a new air-supply system is installed and operating.

34395 (PB–89-137368/XAB) **Preliminary control technology assessment of TWA Maintenance Facility, Kansas City, Missouri, August 18, 1981.** Sheehy, J. National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). 27 Jan 1982. 9p. (ECTB–106-18A). Available from NTIS, PC A02/MF A01.

An onsite visit was made to the TWA Maintenance Facility, Kansas City, Missouri for the purpose of evaluating methods used

to control worker exposures to hazardous materials. Electroplating operations were housed in a large brick building at the site and the processes used include silver cyanide, copper cyanide, cadmium cyanide, and chromic acid baths. Cleaning and stripping operations include perchloroethylene degreasers, sulfuric acid, nitric acid, hydrochloric acid and caustic solutions, and nickel cyanide strip. Most of the plating and cleaning tanks were equipped with local exhaust ventilation. Four of the chrome tanks also had sliding covers. Local exhaust systems vented from three sides of the tanks and exhausted downward through an exhaust tunnel in the floor of the building. An electrically operated roll-up cover was attached to the perchloroethylene degreaser along with a refrigerator chiller. A large make up air unit supplied air to the plating shop. Face shields, respirators and other safety equipment was available. A nurse was on duty at all times and the industrial-hygiene concerns of the facility were handled by two full time persons. The authors recommend this shop for a detailed survey because of the number of potentially hazardous operations.

34396 (PB–89-137376/XAB) **Preliminary survey report. Karastan Rug Mill, Fieldcrest Mills, Inc., Eden, North Carolina, July 14, 1981.** Mortimer, V.D. National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Div. of Physical Sciences and Engineering. 19 Jan 1982. 9p. (ECTB–108-12A). Available from NTIS, PC A02/MF A01.

A visit was made to the Karastan Rug Mill, Eden, North Carolina to evaluate control methods taken to protect workers from hazards associated with the use of adhesives. Adhesives were mixed in a small room just beyond the rollup area of the backsizing operation. In the backsizing operation, the carpet feed and roller/coating operations were followed by a drying oven, a cool-down unit, and the roll-up or doffing area. Two workers per shift were required on the backsizing line. The coating of the underside of the carpet with a latex adhesive binds the carpet fibers to the backing and stiffens the carpet. A styrene/butadiene (SBR) latex containing ammonia as an emulsion stabilizer was used as the base. Exhaust ventilation was used for the oven. Ammonia was the only contaminant noticeable in the workplace environment. At the edge of the coated carpet as it was entering the oven a level of 25 parts per million (ppm) ammonia was detected. A level of 30 ppm was detected alongside the coating rollers. A canopy hood was operated in the compounding room to draw away dust released when adding powdered chemicals to the reactor. An exhaust fan was mounted on the wall opposite the doorway of the latex storage building. If the carpet industry is included in the in-depth study phase, this site would be a prime candidate for a detailed survey.

34397 (PB–89-137434/XAB) **Health-hazard evaluation determination report No. 77-27-437, Keller Aluminum Furniture of Indiana, Linton, Indiana.** White, G.L.; Stroman, R.E.; Colligan, M. National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Oct 1977. 28p. (HHE–77-027-437). Available from NTIS, PC A03/MF A01.

A Health-Hazard Evaluation investigation was conducted by NIOSH on January 31 and February 2 and 7, 1977 at Keller Aluminum Furniture of Indiana, in Linton, Indiana. The survey was prompted by a request from the employer regarding the unknown cause of production-line employee illness (dizziness, headache, nausea, burning throat, weakness) recorded on November 19, 24 and 29, 1976, that involved 96 of the 357 'affected' employees. Environmental and medical studies failed to detect definite evidence that toxic substances caused the outbreaks of illness mentioned. Numerous environmental conditions such as ventilation, noise, dry air, diesel exhaust, a natural gas leak, etc., could have contributed to the outbreaks of illness, but no environmental toxins were found that could totally account for the continuing episodes. Behavioral factors may have been involved, especially since significant psychological differences were found between affected and nonaffected workers. Recommendations are made for improving the work environment.

34398 (PB–89-137467/XAB) **Health-hazard evaluation determination report No. 77-58-428, Steiger Tractor, Inc., Fargo, Nnorth Dakota.** Gunter, B.J.; Ruhe, R.L.; Zey, J.N. National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Sep 1977. 14p. (HHE–77-058-428). Available from NTIS, PC A03/MF A01.

A Health-Hazard Evaluation investigation was conducted by NIOSH on May 9-13, 1977 at Steiger Tractor, Inc., Fargo, North Dakota. Xylene, toluene, isopropanol, 1,1,,1-trichloroethane, petroleum-naphtha, iron-oxide, manganese, aluminum, and lead exposures were investigated. Area and personal air sampling was conducted to detect welding and painting fumes in work areas employing 100 people. Medical and work histories were collected from 64 workers. Exposures to iron-oxide, lead-xylene, and isopropanol exceeded OSHA standards of 10.0, 0.2, 435.0, and 980.0 milligrams per cubic meter, respectively, for only a very low percentage of the total work force. Although these exposures were in excess of standards, no health hazard was suggested. Symptoms generally related to welding fumes and solvent overexposures were reported by 32% of the interviewed workers.

34399 (PB–89-137509/XAB) **Hazard-evaluation and technical assistance report TA 78-12, Oregon State University, Corvallis, Oregon.** National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). May 1978. 14p. (HETA–78-000-012). Available from NTIS, PC A03/MF A01.

A hazard evaluation and technical assistance survey of the biology-botany science building at the University of Oregon, Corvallis Campus to determine a possible etiologic agent responsible for nervous-system complaints among employees was conducted. Upon occupation of the new building formerly healthy plants transplanted to the new laboratories died. Since that time, a plant pathologist died of a neurological disease and three other professors contracted a similar progressive neurological disease. The ventilation system of the building was studied. Fume-hood rates were measured and air-inlet filters were analyzed. In addition, medical interviews of employees were conducted, medical histories obtained, and consultations with their physicians held. If there is a single process endemic among the present staff, it could not be identified, although there are definitely similarities in complaints. No pathophysiological link between the fatal neurological diseases and current complaints among the staff was found. No clear-cut etiologic relationship between the work environment and symptoms was apparent.

34400 (PB–89-137517/XAB) **Health-hazard evaluation determination report No. 74-24-246, Uncle Bill's Pick-N-Pay Market, No. 10, Middleburg Heights, Ohio; 74-92-246, Madsen's Valu Center, Mankato, Minnesota; 74-95-246, Kroger Company, Logan, West Virginia.** Vandervort, R.; Brooks, S.M. National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Dec 1975. 31p. (HHE–74-024-246). Available from NTIS, PC A03/MF A01.

Also includes HHE-74-095-246.

Workers were given a respiratory questionnaire, pulmonary function tests, and complete blood tests to evaluate potential health hazards in the meat cutting and wrapping departments of each of the following supermarkets: Uncle Bill's Pick-N-Pay Market, Madsen's Valu Center, and Kroger Company. The establishments were visited between April and October 1974. Evaluation requests came from authorized representatives of meat department employees working at these supermarkets who were concerned about the toxic effects of substances emitted by thermal cutting of polyvinyl chloride (PVC) packaging films. Twenty-four meat wrappers, 8 meat cutters and 20 control subjects were studied. Respiratory and nasal symptoms were common and 3 meat cutters had chronic symptoms of asthma or rhinitis. Results of blood analyses indicated no increases in white blood cell or total eosinophil counts. The authors conclude that there is no apparent risk of exposure to vinyl chloride monomer. They recommend that concentrations of air contaminants be reduced and ventilation be improved.

34401 (PB–89-137806/XAB) **Preliminary survey report: Steelcase, Incorporated, Grand Rapids, Michigan, September 23, 1981.** Martinez, K.F. National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). 2 Feb 1982. 9p. (ECTB–108-15A). Available from NTIS, PC A02/MF A01.

An on-site visit was made to Steelcase, Incorporated, Grand Rapids, Michigan for the purpose of observing the processes involving adhesives, emphasizing the method of application and methods of controlling exposures to workers. Initial investigations focused on the use of adhesives in the manufacture of partitioning panels, chairs, and desks. Each process involved the spraying of solvent-borne contact adhesives, both flammable and nonflammable.

Solvent-vapor concentrations were adequately controlled through the use of ventilation booths. The spray guns were interlocked with the ventilation system. These booths were designed primarily to control the fire hazard present in using a flammable adhesive. There were some applications that are too large and must be carried on outside the booth. Personal protective equipment was not required for every worker but was available if requested. Most employees wore safety shoes and safety glasses. Gloves were worn by those working with adhesives. A preemployment physical was a requirement and periodic examinations were given to those workers who function in a hazardous environment. The author concludes that this company would be a strong candidate for an in-depth survey if the furniture industry is selected for a detailed study.

34402 (PB–89-137863/XAB) **Preliminary survey report: control technology for formaldehyde emissions at Drexel Heritage Plant 60, Morganton, North Carolina, August 31, 1982.** Mortimer, V.D. National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). 8 Jul 1983. 12p. (ECTB–108-24A). Available from NTIS, PC A03/MF A01.

A visit was made to the Drexel Heritage Facility No. 60, Morganton, North Carolina for the purpose of observing the processes and associated controls for veneering wood panels using heated platen presses. Specific concern was expressed about controlling formaldehyde emissions. At this specific site, veneered panels were produced by both the hot press and the radiofrequency (R/F) press methods. A canopy hood exhausted through a duct to a roof fan was installed about 4 feet above the inspection platform of each feed through press. A small canopy hood covers a small mixer on the main floor. Auxiliary fans were placed throughout the facility. A few ceiling vents were noted, but the only makeup air was the filtered air returned from the dust collection system in winter. Each canopy hood captured only part of the emissions which rose from the platform. The volumetric airflow rate was not sufficient to capture vapors much beyond the boundary of the large canopy opening. Partial shift time weighted average formaldehyde concentrations were all less than 0.5 parts per million (ppm), except around the large R/F press where some peak concentrations were 3 ppm. The author concludes that this facility offers a unique opportunity to study the effectiveness of a canopy hood over an unloading platform.

34403 (PB–89-137871/XAB) **Walk-through survey report: control technology for adhesives at National Veneer Plant, Broyhill Furniture Industries, Inc., Lenoir, North Carolina, September 1, 1982.** Hollett, B.A. National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Feb 1983. 17p. (ECTB–108-25A). Available from NTIS, PC A03/MF A01.

A walk-through survey was conducted at the National Veneer facility, Broyhill Furniture Industries, Inc., Lenoir, North Carolina to determine the effectiveness of control measures used at this facility. Specific attention was given to the control of formaldehyde vapors as they are emitted from heated process veneering operation using a urea/formaldehyde resin. This facility had a complete veneer manufacturing process including cutting the veneer from the logs. They manufactured laminated wood panels and parts. Each of the three radiofrequency (RF) presses in operation had a local exhaust system, and doors with gridded openings which formed the sides of the enclosure and permitted operator access. Time-weighted average airborne formaldehyde samples were collected from the breathing zones of the press operators as well as from work-area air. Breathing-zone formaldehyde concentrations ranged from below 0.37 to 0.53 mg/m^3. The highest worker exposure to formaldehyde appeared to be during the separation of the hot boards. With minor alterations in this activity, a backdraft could be created across the hot pieces and into the hood face. The author concludes that this facility represents an opportunity to observe a well-defined control method at three different levels of performance on three presses.

34404 (PB–89-137889/XAB) **Preliminary survey report: control technology for formaldehyde emissions at Baker Furniture Company, Mocksville, North Carolina, September 2, 1982.** Mortimer, V.D. National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). 28 Jul 1983. 11p. (ECTB–108-26A). Available from NTIS, PC A03/MF A01.

An on-site visit was made to the Baker Furniture Company, Mocksville, North Carolina to observe the processes and associated controls for veneering wood panels using heated platen presses. The facility manufactured furniture and produced veneered panels. For flat panels, the hot-press process was used exclusively. There was some radiofrequency (RF) laminating of small parts and frames. Less than 5,000 square feet of panels were produced per day. The veneer department consisted of 35 workers, eight assigned to the hot press operation. For most applications, a urea/formaldehyde resin was used as the adhesive. There were canopy hoods over the feed-through press and the shuttle press. General ventilation was provided mainly by open doors and an extensive local exhaust ventilation for controlling sawdust. Formaldehyde concentrations ranging from less than 1 part per million (ppm) to between 1 and 2 ppm were noted around the feed-through press in the morning. Concentrations of 1 to 3 ppm were noted at the glue mixing station, loading platform, and unloading area in the afternoon. The general airflow through the space between the press and face of the canopy appeared to carry some emission into the work place. The author notes that this facility offers the opportunity to study a canopy hood over a feed-through press, but the low production rate may preclude an accurate evaluation of control-system effectiveness.

34405 (PB–89-137897/XAB) **Preliminary survey report: control technology for formaldehyde emissions at Jasper Laminates, Jasper, Indiana, October 19, 1982.** Mortimer, V.D. National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). 29 Jul 1983. 11p. (ECTB–108-28A). Available from NTIS, PC A03/MF A01.

An onsite visit was made to Jasper Laminates, Jasper, Indiana to observe the processes used in veneering wood panels by a heater platen press method, and methods of controlling formaldehyde emissions. The facility produced panels for pianos, organs, office furniture and other wood products, using primarily the hot press process along with some radiofrequency (RF) pressing of curved panels and small parts. The glue most often used was a urea/formaldehyde resin adhesive. The hot presses were located under one large ventilated enclosure, measuring about 20 by 150 feet. There were also eight ventilation fans in the ceiling and auxiliary fans used to provide additional cooling air for workers and for the caul plates. Therefore, the primary methods of controlling formaldehyde exposure were dispersion, using auxiliary fans, and area ventilation. No partial-shift-time weighted-average formaldehyde concentrations were measured at over 1 part per million (ppm). For two workers unloading different hot presses, short-term breathing-zone concentrations occasionally reached 2 ppm. The author concludes that this facility offers the opportunity to study large-scale area ventilation with passive make-up air supply, and the appropriate use of auxiliary fans.

34406 (PB–89-138457/XAB) **Toxic Air Pollutant Emission Factors: information storage and retrieval system. User's manual. Final report.** Radian Corp., Research Triangle Park, NC (USA). Oct 1988. 97p. (EPA–450/2-88/006B). Available from NTIS, PC A05/MF A01.

See also PB–89-135644.

This report presents instructions on the Air Toxics Emission Factor data management system. The system was designed to allow easy access and updates to the emission factor data presented in the accompanying EPA report, Toxic Air Pollutant Emission Factors - A Compilation For Selected Air Toxic Compounds And Source, EPA-450/2-88-006a. The software system is an IBM PC-based application that contains a listing of emission factors categorized by pollutant name, Chemical Abstracts Services (CAS) number, industrial process description, Standard Industrial Classification (SIC) code, emission-source description, and source classification code (SCC). The program has modules that allow users to search, add, edit, and print data. The purpose of the report is to document the usage of the system. EPA is making available the system and data to agency users on two regular (360KB) diskettes or one high density (1.2 MB) diskette.

34407 (PB–89-138689/XAB) **Protocols for generating unit-specific emission estimates for equipment leaks of VOC (volatile organic compounds) and VHAP (volatile hazardous air pollutants). Final report.** Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and

Standards. Oct 1988. 109p. (EPA–450/3-88/010). Available from NTIS, PC A06/MF A01.

EPA has developed a Protocol for Generating Unit-Specific Emission Estimates for Equipment Leaks of VOC and VHAP. The protocol provides several methods for estimating emissions from equipment leaks. These methods range from the application of average emission factors for the equipment component inventory to the use of bagging data for generating unit-specific leak rate/screening value correlations. In addition, the protocol provides technically sound methods of source screening and mass emissions sampling (bagging). The document will help facilities generate accurate plant-specific equipment leak emissions.

34408 (PB–89-138713/XAB) **Health-hazard evaluation determination report No. 76-115-425, H F E Inc., Ft. Collins, Colorado.** Burroughs, G.E. National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Sep 1977. 14p. (HHE–76-115-425). Available from NTIS, PC A03/MF A01.

A Health-Hazard Evaluation investigation was conducted by NIOSH on February 1-2 and on May 17, 1977, at the H F E, Inc., Ft. Collins, Colorado, a facility engaged in the manufacturing of farm equipment used primarily in the sugar-beet industry. The evaluation was prompted by a request from an authorized management representative regarding employee exposure to welding fumes, paint spray, and forklift exhaust. Environmental sampling indicated that all employees were potentially exposed to toxic concentrations of paint solvents, dust, welding fumes, and carbon monoxide. This determination was consistent with the responses obtained from 36 of the approximately 40 'affected' employees investigated by means of non-directed medical questionnaires; 23 of the workers questioned complained of some form of respiratory irritation, headaches, 'nerves,' or high blood pressure, all which could be caused or aggravated by acute exposure to dust, fumes, and carbon dioxide. Recommendations are made for improving prevailing conditions.

34409 (PB–89-138994/XAB) **Health-hazard evaluation determination report No. 74-97-286, Blaw Knox Foundry and Mill Machinery, Inc., Warwood Plant, Wheeling, West Virginia.** Straub, W.E.; Rostand, R. National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). May 1976. 24p. (HHE–74-097-286). Available from NTIS, PC A03/MF A01.

Based on the results of environmental and medical studies by NIOSH, a toxic exposure to crystalline-free silica is determined to exist among foundry workers in the Blaw Knox Foundry and Mill Machinery, Incorporated, Warwood Plant, Wheeling, West Virginia. The workroom air concentrations exceed the current NIOSH standard of 0.05 milligram per cubic meter. Employees were also transiently exposed to phosphine generated in the machining of nodular iron rolls. The possibility of metal fumes and calcium-oxide transiently exceeding the current safety limits during tapping operations was suspected because of the episodic and transient symptoms of mucous membrane and skin irritation noted by cranemen and pitmen. Recommendations include use of low-silica-containing sand, good housekeeping, better exhaust ventilation, regular wetting of foundry sand with water, mechanizing the shakeout procedures, use of breathing apparatus, long-sleeve shirts and gloves by cranemen, and repairing the seal on the crane cabs.

34410 (PB–89-139232/XAB) **Health-hazard evaluation report HETA 87-112-1922, E.S.I. Meats, Inc., Bristol, Indiana.** Galson, S.K.; Boiano, J.M. National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Aug 1988. 32p. (HETA–87-112-1922). Available from NTIS, PC A03/MF A01.

In response to a request from three employees at E.S.I. Meats, Inc., Bristol, Indiana, an investigation was made of respiratory symptoms among workers exposed to meat tenderizers. The facility was a meat-portioning plant which used the proteolytic enzyme meat tenderizer papain as a component of spice mixtures sprayed on some steaks prior to packaging. Medical studies indicated that immunoglobulin-E mediated tenderizer related occupational asthma (TROA) occurred among the workers. The prevalence of possible or definite TROA among this workforce was at least 8% and the prevalence among tenderizer exposed workers was at least 12%. The prevalence among symptomatic workers was 58%. Immunologic sensitivity to tenderizer in the absence of reported symptoms, observed in 11 participants, may be a predictor of the development of asthma with continued exposure. The authors conclude that a hazard existed from occupational exposure to proteolytic enzyme meat tenderizers. The authors recommend that worker exposure to proteolytic enzymes be reduced as low as possible through better engineering controls. Appropriate respiratory protection should be used until effective engineering controls are in place. All skin contact with the spice solutions or meat treated with spice should be avoided.

34411 (PB–89-139240/XAB) **In-depth survey report of silica flour dust during packing, transfer, and shipping at Ottawa Silica Company, Ottawa, Illinois.** Caplan, P.E.; Reed, L.D.; Amendola, A.A.; Cooper, T.C. National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Div. of Physical Sciences and Engineering. Apr 1981. 30p. (ECTB–120-11A). Available from NTIS, PC A03/MF A01.

A visit was made to the Ottawa Silica Company, Ottawa, Illinois to evaluate innovative control methods used to keep the exposure of workers to silica-flour dust at a minimum. Silica sand ore was pumped as a wet slurry from the quarry to a processing building where it was washed and sized on stationary wet screens. Exhaust ventilation was provided at each packer station and consisted of several collection points. Water was injected into the product at each filler spout to reduce the emission of dust from silica-flour products. Sonic sprayers were installed at three strategic locations. Water was sprayed on top of the bags to remove dust from the valve area near the fill spouts. Water was sprayed at the transfer point both upward and downward on the bags to remove dust. At the transfer point from the declining conveyor to the horizontal transfer conveyor, water was sprayed from both sides to wash the sides of the bags. The authors recommend the use of respiratory protection in all work areas, as a preventive measure when dust control measures fail. Good local control ventilation is needed. Proper ventilation design requires both sufficient air movement and the development of effective flow patterns.

34412 (PB–89-139257/XAB) **In-depth survey report of silica flour dust during packing, transfer, and shipping at the Central Silica Company, Glass Rock Plant, Glass Rock, Ohio.** Caplan, P.E.; Reed, L.D.; Amendola, A.A.; Cooper, T.C. National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Div. of Physical Sciences and Engineering. Dec 1981. 24p. (ECTB–120-12A). Available from NTIS, PC A03/MF A01.

See also PB–89-139240.

A visit was made to the Central Silica Company, Glass Rock, Ohio to evaluate methods used to control employee exposure to silica dust. The control methods at this company included careful handling and transfer of damp materials, exhaust ventilation, good housekeeping procedures, and the use of respiratory protection. Evaluations were made of the packing area, transfer point, inside loading trucks, and ambient air at sections of the flour building. Control systems included a good exhaust-ventilation system and four ventilation hoods. Evaluations were made of samples collected by an MSA gravimeter dust sampler, the Del High volume electrostatic precipitation, and bulk and rafter samples. Dust control methods appeared to be effective due to the existence of good engineering controls, good work practices, and an effective respiratory protection program. Additional control measures included the handling of the ore as a damp material, thus reducing the generation of dust particles. Outside dust sources were being reduced. Most of the product was shipped in bulk. Plastic wrapping was used around pallet loads to reduce bag breakage and dust dispersion. A filtered air system controlled low dust levels in the Pebble Mill control room. Enclosed screens operated under negative pressure separated fine from coarse product at the process building.

34413 (PB–89-139265/XAB) **In-depth survey report of silica flour dust during packing, transfer, and shipping at Pennsylvania Glass Sand Corporation, Berkeley Springs, West Virginia.** Caplan, P.E.; Reed, L.D.; Amendola, A.A.; Cooper, T.C. National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Div. of Physical Sciences and Engineering. Sep 1981. 36p. (ECTB–120-13A). Available from NTIS, PC A03/MF A01.

See also PB–89-139257.

A visit was made to Pennsylvania Glass Sand Corporation, Berkeley Springs, West Virginia to evaluate control measures in

place to protect workers from silica dust exposures. Two dust suppressant techniques were in use. The first used an agglomerating/foaming agent, Deter(R), sprayed into whole grain sand during its transfer through the old screen tower building. The second used exhaust ventilation during the bulk loading of silica-flour into enclosed hopper cars. Exhaust-ventilation systems were used to capture point source emissions from the six pebble mills, the three packer stations and the bulk loading stations. An exhaust-ventilation system was also used to control dust emissions during the bulk loading of silica-flour into closed hopper trucks and railroad cars. The injection of the agglomerating agent reduced dust emissions by 20 to 67%. The bulk loading of silica-flour under local exhaust ventilation reduced dust levels from 90 micrograms/cubic meter total dust and 80 micrograms/cubic meter silica dust. The local exhaust ventilation systems at the three silica-flour packing stations showed varying degrees of effectiveness as a result of the design, total air-movement control, and housekeeping practices. Other existing and planned control strategies were briefly discussed.

34414 (PB–89-139570/XAB) **Acceptable levels of dioxin contamination in an office building following a transformer fire.** National Research Council, Washington, DC (USA). Commission on Life Sciences. 1988. 33p. Available from NTIS, PC A03/MF A01.

This report assesses the health effects of dioxin in order to determine acceptable levels of exposures to dioxin in an office building that had a PCB transformer fire. The Committee concluded that short-term exposures to high concentrations of dioxins (especially 2,3,7,8 tetrachlorodibenzodioxin) are associated with chloracne in humans. Studies concerning reproductive effects have not shown adverse effects among progeny of men who were exposed to dioxins. The results of human-cancer studies of exposure to dioxins are inconsistent, but in general the studies are of low power and inconclusive exposure assessment. The overall evidence from human studies does not indicate a greatly increased risk of cancer in association with exposures experienced. Studies in animals have shown increased risk of cancer, adverse reproductive effects, and alterations in immune function. Acute effects include body-weight loss, thymic atrophy, neurotoxicity, and liver effects. Various carcinogenic risk assessments were reviewed and the Committee decided that the approach taken by the New York State Health Department was most appropriate and adopted its exposure guidelines, i.e., 10 pg/cu m for air and 25 ng/sq m for surfaces.

34415 (PB–89-140180/XAB) **Industrial-hygiene-survey report of Martin Marietta Missile and Electronics Group, Orlando, Florida, April 25-27, 1988.** Piacitelli, G.; Votaw, D.M.; Krishnan, E.R. National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). 9 Sep 1988. 23p. (IWS–134.20.10). Available from NTIS, PC A03/MF A01.

A walk-through survey was made of the Martin Marietta Missile and Electronics Group, Orlando, Florida to evaluate worker exposure, protective equipment, and engineering controls used to reduce employee exposures to 2-methoxyethanol (2-ME), 2-methoxyethyl acetate (2-MEA), 2-ethoxyethanol (2-EE), and 2-ethoxyethyl-acetate (2-EEA). The facility was involved in the design, development, and production of missile and electro-optical systems used for aircraft and naval combat weapons programs. Of 38 field samples collected for each of the four target ethylene glycol ethers, only nine samples indicated the presence of any of the compounds and one sample indicated more than one to be present. Some skin protection was afforded by gloves, but the workers wore only ordinary street clothes and no respirators. Peak exposures to 2-EEA in the Hellfire area occurred during the spray painting of missiles. The authors recommend that local exhaust ventilation be installed at work stations in the Patriot area and that impermeable coveralls be given to workers in the Hellfire and Patriot areas.

34416 (PB–89-140198/XAB) **Health-hazard evaluation determination report No. 76-54-436, Certain-Teed Products, Inc., Richmond, California.** Okawa, M.T.; Apol, A.G. National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Oct 1977. 23p. (HHE–76-054-436). Available from NTIS, PC A03/MF A01.

A Health-Hazard Evaluation investigation was conducted by NIOSH on September 29-30, 1976 to determine whether materials used in the production of asphalt shingles and rolled roofing materials are toxic in the concentrations found at the Certain-Teed Products Corporation plant, Richmond, California. The evaluation was prompted by a request from an authorized employee representative regarding the exposure of approximately 50 'affected' employees to various toxic dusts and fumes. Environmental surveys revealed that employees working in and around the coater line for roofing shingles were exposed to excessive concentration of limestone and other nuisance dusts, while those employed in the slate operation were exposed to potentially toxic concentrations of a dust which contain crystalline silica. There were only signs of irritation from exposure to dust and fumes among the 18 employees interviewed.

34417 (PB–89-140206/XAB) **Health-hazard evaluation determination report No. 76-43 A-F-429, Hersey Products Company, Inc., Gilbertville, Massachusetts.** Kominsky, J.R.; Thoburn, T.W. National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Sep 1977. 59p. (HHE–76-043-429). Available from NTIS, PC A04/MF A01.

A Health-Hazard Evaluation investigation was conducted by NIOSH on April 22, June 29-30, and July 1, 1976 at the Hersey Products Company, Inc. in Gilbertville, Massachusetts, a facility engaged in the founding of ferrous and non-ferrous castings. The evaluation was requested by management regarding exposure of approximately 60 'affected employees' to vapors, gases, oxides, and particulates. Environmental evaluation revealed that the shell and no-bake core makers, metal pourers, and snagger-grinder operators employed in the ferrous foundry were exposed to toxic or potentially toxic concentrations of respirable crystalline silica dust, or carbon monoxide, or iron oxide and total particulates. Non-ferrous foundry workers were exposed to toxic concentrations of crystalline silica, or inorganic lead; the 5 non-ferrous foundry workers complained of a metallic taste and occasional recurrent chills suggestive of what is commonly known as 'brass chills.' Recommendations are made for improving the prevailing environmental conditions, use of respiratory protective equipment, and medical surveillance.

34418 (PB–89-140214/XAB) **Health-hazard evaluation determination report No. 76-18-288, Syntex Fabrics, Inc., Williamsport, Pennsylvania.** Rosensteel, R.E.; Meyer, C.R. National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). May 1976. 24p. (HHE–76-018-288). Available from NTIS, PC A03/MF A01.

A combined environmental medical evaluation conducted at the Syntex Fabrics, Incorporated, Williamsport, Pennsylvania shows that a potential health hazard from exposure to dust containing cotton may exist to workers exposed in Area One of the Weaving Department. Although no case of byssinosis has occurred during eight weeks' operation of the weaving process, there is evidence that upper-respiratory irritation is present to a greater degree in workers from Area One than in the surrounding areas. Recommendations include the adoption of recommendations in the NIOSH Criteria Document for cotton dust by Syntex Fabrics, and audiometric testing and X-ray of the chest as part of pre-employment examination.

34419 (PB–89-140230/XAB) **Health-hazard evaluation determination report No. 75-181-287, Fibreboard Corporation, Stockton, California.** Okawa, M.T. National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). May 1976. 9p. (HHE–75-181-287). Available from NTIS, PC A02/MF A01.

Employees in the Litho Department of the Fibreboard Corporation Plant in Stockton, California are not found to be exposed to toxic concentrations of dusting powders, but are exposed to airborne dust levels from the powders which exceed the State of California OSHA standard and the threshold limits for nuisance dust. Safety recommendations include servicing of exhaust ventilation systems regularly, vacuum cleaning instead of dry sweeping, and making NIOSH Certified Respirators available whenever needed.

34420 (PB–89-140255/XAB) **Health-hazard evaluation report HETA 87-307-1917, Downing Displays, Inc., Cincinnati, Ohio.** Almaguer, D. National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Aug 1988. 17p. (HETA–87-307-1917). Available from NTIS, PC A03/MF A01.

In response to a request from the management at Downing Displays, Inc., Cincinnati, Ohio, a study was made to investigate eye,

nose and throat irritation in workers. Downing Displays manufactured portable displays for use in advertising and sales promotion. Initially, workers suspected the irritating odor to be arising from a sewer drain. Further study revealed that the source was probably an adhesive product which contained trace quantities of formaldehyde. Air in the breathing zone of the workers contained formaldehyde at 0.23 to 0.28 parts per million, while general air samples contained 0.23 to 3.3 parts per million; NIOSH has recommended that occupational exposures to formaldehyde be to the lowest feasible level. Adhesive made from Lot CUR-368 was also demonstrated to contain five to seven times the formaldehyde contained in adhesive from lots CFR-105 and CER-180. The author concludes that workers were exposed to formaldehyde concentrations in excess of the Recommended Exposure Limit. The author recommends that an adhesive which does not contain formaldehyde be substituted, appropriate engineering controls be implemented, personal and general area air monitoring be conducted, and that the manufacturer of Lot CUR-368 be informed of the excess formaldehyde in this formulation.

34421 (PB–89-140263/XAB) **Health-hazard evaluation report HETA 86-461-1920, Ballas Egg Products Corporation, Zanesville, Ohio.** Smith, A.B.; London, M.A.; Wallingford, K.; Ornella, G.A.; Newman, M.A. National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Aug 1988. 46p. (HETA–86-461-1920). Available from NTIS, PC A03/MF A01.

In response to a request from the president of Ballas Egg Products Corporation, Zanesville, Ohio, an investigation was made of possible hazardous working conditions at this location. Raw eggs were processed daily at this site into powdered whole egg, powdered egg yolk, and liquid egg white. Workers had complained of asthma-like symptoms. Earlier studies had indicated several workers were experiencing immunoglobulin-E mediated occupational asthma from egg protein exposure. Total aerosol mass concentrations exceeded recommended limits with levels ranging from 11 to 31 mg/m^3. Ambient air concentration for total protein ranged from 0.17 to 130 mg/m^3. Respirable protein concentrations were all less than 0.77/mg/m^3. Ambient air concentrations of ovalbumin, ovomucoid, and lysozyme were less than 223, 351, and 672 micrograms/cubic meter, respectively. Bulk sample analysis of the egg-products indicated a protein concentration of 35 to 81%. A sample of used waste water contained 1 milligram/milliliter of protein. Eight employees demonstrated immunoglobulin-E mediated occupational asthma from egg protein exposure. Six of the eight had lung-function tests indicative of bronchial liability. They conclude that a health hazard existed from occupational exposure to egg protein. The authors recommend measures to reduce exposures to egg protein and screening for at risk workers.

34422 (PB–89-140271/XAB) **Health-hazard evaluation report HETA 86-447-1919, Estherville Foods, Inc., Estherville, Iowa.** Smith, A.B.; London, M.A.; Wallingford, K.; Ornella, G.A.; Newman, M.A. National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Aug 1988. 42p. (HETA–86-447-1919). Available from NTIS, PC A03/MF A01.

In response to a request from the president of Sonstegard Foods, Inc., a study was undertaken of possible hazardous working conditions due to exposure to raw egg products at the Estherville Foods, Inc., located in Estherville, Iowa. The facility processed raw eggs into powdered whole egg, powdered egg yolk, and liquid egg white. Workers experienced asthma-like symptoms including wheezing, shortness of breath, and chest tightness. Ambient air concentrations for total protein were less than 1.2mg/m^3. Ambient air concentrations of ovalbumin, ovomucoid, and lysozyme were less than 360, 243, and 40 micrograms/cubic meter, respectively. Protein concentration in the sanitizer water from the egg washers increased from 0.27 to 5.6 milligrams/milliliter over the course of a work shift. Immunoglobulin-E mediated occupational asthma from egg protein exposure was determined in ten workers; three had evidence of bronchial lability. A major source of egg-protein may be the visible aerosol escaping from the freshly washed eggs. Each wash water was recirculated for the 5-hour production run, and contained contaminants from broken eggs. These mists were also seen to escape into the transfer room. Better control methods at this juncture will reduce exposure levels. The authors concluded that a health hazard existed and that exposure to egg protein be reduced, and at-risk workers be screened.

34423 (PB–89-140297/XAB) **Hazard evaluation and technical assistance report TA 77-63, United States Department of the Interior, National Park Service, Fort Stanwix National Monument, Rome, New York.** Rosensteel, R.E. National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). May 1978. 14p. (HETA–77-000-063). Available from NTIS, PC A03/MF A01.

See also PB–85-101343.

A hazard evaluation and technical assistance survey to determine levels of airborne pentachlorophenol (PCP) at the National Park Service Fort Stanwix National Monument, Rome, New York Office was conducted. Air samples were taken from different locations. Urine samples were collected from employees and health status interviews were conducted. Measurement of airborne PCP levels below the existing Threshold Limit Value (TLV) and Federal Standard were documented in four sampling locations in the park office; the maximum airborne concentration approached 40 percent of the TLV and Federal Standard. The presence of PCP in the work environment was further substantiated by urine PCP levels of office workers which indicated increased absorption of PCP as compared to control specimens. Two of five workers interviewed reported symptoms which they thought were related to the work environment. Medical and environmental recommendations for further amelioration of potential hazards, were given.

34424 (PB–89-155055/XAB) **Prevention reference manual: chemical specific. Volume 15. Control of accidental releases of sulfur trioxide. Final report, June 1987-September 1988.** Davis, D.S.; DeWolf, G.B.; Hummel, K.E.; Quass, J.D. Radian Corp., Austin, TX (USA). Jan 1989. 116p. (DCN–88-239-004-41-07). Available from NTIS, PC A06/MF A01.

See also PB–89-155048.

This report, discussing sulfur trioxide (SO_3), is one of a series addressing the prevention of accidental releases of toxic chemicals. SO_3, a clear oily liquid or solid at typical ambient conditions, has an Immediately Dangerous to Life and Health (IDLH) concentration of 20 ppm, which makes it an acutely toxic hazard. Reducing the risk associated with an accidental release of SO_3 involves identifying some of the potential causes of accidental releases that apply to process facilities that manufacture or use the chemical. The manual identifies examples of potential causes and measures that may be taken to reduce the accidental release risk. Such measures include recommendations on plant design practices, prevention, protection, and mitigation technologies, and operation and maintenance practices. Conceptual cost estimates of example prevention, protection, and mitigation measures are provided.

34425 (PNL–6910) **The installation of a multiport groundwater sampling system in the 300 Area.** Gilmore, T.J. Pacific Northwest Lab., Richland, WA (USA). Jun 1989. 40p. Sponsored by DOE Nuclear Energy. DOE Contract AC06-76RL01830. Order Number DE89014794/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

In 1988, the Pacific Northwest Laboratory installed a multiport groundwater sampling system in well 399-1-20, drilled north of the 300 Area on the Hanford Site in southwestern Washington State. The purpose of installing the multiport system is to evaluate methods of determining the vertical distribution of contaminants and hydraulic heads in ground water. Well 399-1-20 is adjacent to a cluster of four Resource Conservation and Recovery Act (RCRA) ground-water monitoring wells. This proximity makes it possible to compare sampling intervals and head measurements between the multiport system and the RCRA monitoring wells. Drilling and installation of the multiport system took 42 working days. Six sampling ports were installed in the upper unconfined aquifer at depths of approximately 120, 103, 86, 74, 56, and 44 feet. The locations of the sampling ports were determined by the hydrogeology of the area and the screened intervals of adjacent ground-water monitoring wells. The system was installed by backfilling sand around the sampling ports and isolating the ports with bentonite seals. The method proved adequate. For future installation, however, development and evaluation of an alternative method is recommended. In the alternative method suggested, the multiport system would be placed inside

a cased and screened well, using packers to isolate the sampling zones. 4 refs., 8 figs., 1 tab.

34426 (SNV–3379) **Action plan 87 against air pollution and acidification.** National Swedish Environmental Protection Board, Solna (Sweden). 1987. 151p. (In Swedish). Order Number DE89776250/JAW. Available from NTIS (US Sales Only), PC A08/MF A01;1.

Problems with acidification and air pollution seem to be more and more troublesome. Not only lakes and streams but also soil and ground water are affected. Forests have been damaged in large areas. This plan describes the situation and also presents proposals for actions to be taken. Among other things more stringent rules for sulphur outlets at combustion, greater environment consideration concerning traffic policy in order to reduce nitrogen oxide and to restrict hydrocarbon outlets are proposed. The program includes also liming of lakes and streams, attempts for lime distribution in forestry and proposal for further work concerning research, control and information. (L.F.).

34427 (SNV–3380) **Action plan 87 against air pollution and acidification.** National Swedish Environmental Protection Board, Solna (Sweden). 1987. 185p. (In Swedish). Order Number DE89776251/JAW. Available from NTIS (US Sales Only), PC A09/MF A01;1.

Appendix to SNV–3379.

Problems with acidification and air pollution seem to be more and more troublesome. Not only lakes and streams but also soil and ground water are affected. Forests have been damaged in large areas. This plan describes the situation and also presents proposals for actions to be taken. Among other things more stringent rules for sulphur outlets at combustion, greater environment consideration concerning traffic policy in order to reduce nitrogen oxide and to restrict hydrocarbon outlets are proposed. The program includes also liming of lakes and streams, attempts for lime distribution in forestry and proposal for further work concerning research, control and information. (L.F.).

34428 (SVF–312) **Low NO_x burners for heavy fuel oil. A prestudy of presently available technique with emphasis on small compactboiler.** Schuster, R. Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden). Oct 1988. 58p. (In Swedish). Order Number DE89776242/JAW. Available from NTIS (US Sales Only), PC A04/MF A01;1.

The consumption of heavy fuel oil in Sweden is 5.1 Mm^3 per year. Some qualities of heavy fuel oil supplied today are produced by cracking processes and contains high quantities of nitrogen and asphaltenes, which increase the emissions of nitrogen oxides and give problems with soot formation. The share of cracked qualities is expected to increase. There are low NO_x burners commercially available today. The results reported from these burners are however not directly transformable to Swedish conditions, as oil qualities and boiler design are different. The objective of the complete project is to promote the use of low NO_x burners in Sweden, by testing and evaluating the technology and publishing of the results. The objective of the first step was among other things to establish the commercial state of the art. The work included asking about 50 burner manufacturers what their burners could achieve in general and with a Swedish boiler from Generator AB and two Swedish oils in particular. The request resulted in 18 answers of which 9 are considered of special interest. The NO_x emission levels estimated by the manufacturers for the Swedish boiler and oils are between 55 to 150 mg/MJ. It is however not yet possible to make a ranking list for the burners, based on the information received. (authors).

34429 (UCRL–98894-Rev.1) **Global environmental effects of impact-generated aerosols: Results from a general circulation model: Revision 1.** Covey, C.; Ghan, S.J.; Walton, J.J.; Weissman, P.R. Lawrence Livermore National Lab., CA (USA). Jun 1989. 21p. Sponsored by DOE Energy Research. DOE Contract W-7405-ENG-48. (CONF-8810341–2: Global catastrophes conference, Snowbird, Utah, USA, 20-23 Oct 1988). Order Number DE89014179/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Interception of sunlight by the high altitude worldwide dust cloud generated by impact of a large asteroid or comet would lead to substantial land surface cooling, according to our three-dimensional atmospheric general circulation model (GCM). This result is qualitatively similar to conclusions drawn from an earlier study that employed a one-dimensional atmospheric model, but in the GCM simulation the heat capacity of the oceans substantially mitigates land surface cooling, an effect that one-dimensional models cannot quantify. On the other hand, the low heat capacity of the GCM's land surface allows temperatures to drop more rapidly in the initial stage of cooling than in the one-dimensional model study. These two differences between three-dimensional and one-dimensional model simulations were noted previously in studies of "nuclear winter;" GCM-simulated climatic changes in the Alvarez-inspired scenario of "asteroid/comet winter," however, are more severe than in "nuclear winter" because the assumed aerosol amount is large enough to intercept all sunlight falling on earth. Impacts of smaller objects – which would occur much more frequently than the Cretaceous/Tertiary event deduced by Alvarez and coworkers – could also lead to dramatic, though less severe, climatic changes, according to our GCM. Our conclusion is that it is difficult to imagine an asteroid or comet impact leading to anything approaching complete global freezing, but quite reasonable to assume that impacts at the Alvarez level, or even smaller, dramatically alter the climate in at least a "patchy" sense. 30 refs., 4 figs., 1 tab.

34430 (UCRL–99926-Rev.1) **Preventing depletion of stratospheric ozone—Implications on future aircraft emissions: Revision 1.** Kinnison, D.E.; Wuebbles, D.J. Lawrence Livermore National Lab., CA (USA). May 1989. 15p. Sponsored by DOE Energy Research. DOE Contract W-7405-ENG-48. (CONF-890692–4-Rev.1: 82. Air and Waste Management Association annual meeting and exhibition, Anaheim, California, USA, 25-30 Jun 1989). Order Number DE89013779/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

There is much renewed interest in the development of faster aircraft for intercontinental passenger flights. Such aircraft would likely spend a large fraction of their flight time in the stratosphere, at altitudes as high as 35 km. It is important, in order to prevent the problems with the proposed supersonic-transport that occurred in the early 1970's, that the aircraft industry work together with the atmospheric science community to insure that future aircraft emissions will not deplete stratospheric ozone. In this study, we have used our two-dimensional model of the troposphere and stratosphere to examine the sensitivity of stratospheric ozone to such emissions. Initial results indicate, for commercial fleets as large as proposed for the original SST and depending on the odd-nitrogen emissions per engine, that substantial decreases in stratospheric ozone could result. The decrease in ozone is sensitive to the altitude and latitude in the emissions. Effects on ozone, for the same emission rate, tend to be larger as altitude increases, until a maximum effect is reached near 30 km. 10 refs., 8 figs.

34431 Examples of regional environmental assessment using acid deposition data. Olson, R.J. (Information Research Organization, Oak Ridge National Lab., Oak Ridge, TN (US)); Turner, R.S.; Allison, L.J. v.v of Proceedings of the national conference on hazardous wastes and environmental emergencies. Hazardous Materials Control Research Institute, Silver Spring, MD (1985). (CONF-8505149–: National conference on hazardous wastes and environmental emergencies, Cincinnati, Ohio, USA, 14-16 May 1985).

Integrated assessments of acid deposition impacts require data on pollutant emissions, pollutant deposition, air quality, aquatic resources, crops, forests and man-made materials. These data must have common spatial and temporal attributes that can be readily accessed for statistical analysis, modeling and display purposes. The Acid Deposition Data Network (ADDNET) at Oak Ridge National Acid Deposition Data Network (ADDNET) at Oak Ridge National Laboratory to provide accurate and reliable data to conduct assessment and policy analysis for the National Acid Precipitation Assessment Program (NAPAP). Although specific projects and task groups within NAPAP collect and analyze individual data files, ADDNET assembles selected files, verifies their contents, conducts quality assurance, maintains documentation and makes data available to the NAPAP community. The ADDNET data base contains over 65 certified data sets that have been screened to ensure consistency across all areas of the assessment. Two applications of the

ADDNET data base to assessment activities are described: estimation of the extent of sensitive lakes at risk to high atmospheric deposition and the mapping of regional soil properties according to hypothesized sensitivity criteria. Both examples cover New York and New England states and show the integration of data from diverse sources for analyses. The data resources and the regional environmental assessment approach described here can be applied directly to other hazardous materials discussed at this symposium.

34432 Acid rain. Barchet, W.R. (Geosciences Research and Engineering Dept., Pacific Northwest Lab., Richland, WA (US)). v.v of Proceedings of the national conference on hazardous wastes and environmental emergencies. Hazardous Materials Control Research Institute, Silver Spring, MD (1985). (CONF-8505149–: National conference on hazardous wastes and environmental emergencies, Cincinnati, Ohio, USA, 14-16 May 1985).

Acid rain is introduced by defining its components: wet and dry deposition. Data bases on precipitation chemistry from several monitoring networks are used to show where acid rain occurs. Precipitation chemistry and air quality data are used to discuss what is in acid rain. Maps of the deposition of the major constituents of wet deposition are presented to contrast the amount of material deposited (deposition) in acid rain with its composition (concentration). The interactions of acid rain with the surfaces on which it falls are used to trace the paths by which acid rain reaches surface and soil waters. Implications of acid rain effects are introduced but not discussed in detail.

5003 Radioactive Materials Monitoring and Transport

Refer also to citation(s) 33737, 34349, 34477, 34478, 34505, 34506, 35491

34433 (AECL–9056) **Radioactivity levels in Winnipeg river fish at the Whiteshell Nuclear Research Establishment near Pinawa, Manitoba. 1963-1978.** Guthrie, J.E.; Acres, O.E.; Dunford, W.E. Atomic Energy of Canada Ltd., Pinawa, MB (Canada). Whiteshell Nuclear Research Establishment. Mar 1986. 84p. Order Number DE89619713/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

Routine monitoring of biologically important radioactivity levels in Winnipeg River fish started in 1963, two years before operation of the Hot Cell Facility and the WR-1 reactor commenced at the Whiteshell Nuclear Research Establishment (WNRE), near Pinawa, Manitoba, Canada. Fish were captured with commercial-size fishing nets set twice a year near the town of Pinawa (upstream of WNRE and the Seven Sisters Hydroelectric Generating Station) and 0.5 and 5 km downstream from WNRE. Radioactivity levels in fish taken downstream of WNRE showed a general increase in the late sixties, due to fallout from global nuclear weapons testing, and some increase in the late seventies, due to radio-nuclide releases from the Hot Cell Facility of WNRE. The average concentration of radioactive cesium in the flesh of fish caught downstream of WNRE varied between 0.003 and 0.027 Bq/g wet weight prior to 1971 and between 0.002 and 0.075 Bq/g wet weight in the period 1976 to 1978, depending on species. The radiological dose to a human (committed effective dose equivalent) from the consumption of 20 kg of downstream pickerel in 1978 was approximately 0.013 mSv due to ^{137}Cs.

34434 (KFK–4519) **Analysis of site-specific dispersion conditions.** Paesler-Sauer, J. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik. Mar 1989. 89p. (In German). Order Number DE89783050/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

This report presents an analysis of atmospheric dispersion conditions in the environs of nuclear power stations in the Federal Republic of Germany. The analysis is based on meteorological data measured on the power station sites (KFUe = nuclear reactor remote control records) and by neighbouring stations operated by the German Weather Service. The data are series of hourly mean values of wind and temperature gradient or stability class over the period of one or more years. The aim of the data analysis is to find types of dispersion conditions characterized by the flow field and stratification, and to assess the feasibility of calculating these quantities in the case of an emergency. Influences of terrain structures in the environs of the site are considered. The annual frequencies of types of dispersion situations are assessed, the capability to recognize the dispersion situation from meteorological data measured on the site and the applicability of dispersion models are discussed.

34435 (OEVS-Mitteilung–1988, pp. 130-142) **Modifications of the natural radiation exposure and its impact on society.** Steinhaeusler, F. (Salzburg Univ. (Austria). Inst. fuer Allgemeine Biologie, Biochemie und Biophysik). Oesterreichischer Verband fuer Strahlenschutz (OeVS), Vienna (Austria). Nov 1988. (CONF-860969–: 4. European congress and 13. regional congress of the International Radiation Protection Association, Salzburg, Austria, 15-19 Sep 1986). In *4. European congress and 13. regional congress of IRPA. 20 years experience in radiation protection - a review and outlook.* Order Number DE89613806/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

Present and past industrial practices, energy production and recycling of wastes can result in an intentional or unintentional exposure of workers and members of the public to elevated levels of the natural radiation environment (NRE). Reviewing a variety of NRE-sources the most important ones with regard to individual and collective risk are: indoor radon daughter exposure and the use of peat as fuel. An integral approach to NRE-control above a level of insignificance of $\leq$0,2 mSv/year is proposed. 32 refs., 1 fig., 4 tabs.

34436 (OEVS-Mitteilung–1988, pp. 172-176) **Vertical transport and distribution of radon decay products between different floors.** Crameri, R. (2314000CH); Furrer, D.; Burkart, W. Oesterreichischer Verband fuer Strahlenschutz (OeVS), Vienna (Austria). Nov 1988. (CONF-860969–: 4. European congress and 13. regional congress of the International Radiation Protection Association, Salzburg, Austria, 15-19 Sep 1986). In *4. European congress and 13. regional congress of IRPA. 20 years experience in radiation protection - a review and outlook.* Order Number DE89613806/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

Concentrations of radon decay products in dwellings undergo a periodical fluctuation. Source term and vertical distribution in single family homes were studied using continous monitoring techniques, passive integrating measurements and tracer gas distribution. Strong correlations between radon decay products concentrations in the cellar and higher floors as well as a correlated vertical transport of tracer gas (N2O) and radon decay products are reported. 3 refs., 5 figs., 2 tab.

34437 (OEVS-Mitteilung–1988, pp. 239-242) **Spread of ingestion doses after short releases of radionuclides into the atmosphere.** Mueller, H. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Inst. fuer Strahlenschutz); Paretzke, H.G.; Proehl, G.; Sonsalla, L. Oesterreichischer Verband fuer Strahlenschutz (OeVS), Vienna (Austria). Nov 1988. (In German). (CONF-860969–: 4. European congress and 13. regional congress of the International Radiation Protection Association, Salzburg, Austria, 15-19 Sep 1986). In *4. European congress and 13. regional congress of IRPA. 20 years experience in radiation protection - a review and outlook.* Order Number DE89613806/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

The dynamic code ECOSYS-85 for calculation of the individual doses and their variation width after activity release from accidents is presented and some typical results shown. 1 ref., 5 figs., 1 tab.

34438 (OEVS-Mitteilung–1988, pp. 204-208) **Application of passive and active methods paralell to the measurements of local climatic parameters for the assessment of Rn-222 behaviour in selected Swiss dwellings.** Pensko, J. (2314000CH). Oesterreichischer Verband fuer Strahlenschutz (OeVS), Vienna (Austria). Nov 1988. (CONF-860969–: 4. European congress and 13. regional congress of the International Radiation Protection Association, Salzburg, Austria, 15-19 Sep 1986). In *4. European congress and 13. regional congress of IRPA. 20 years experience in radiation protection - a review and outlook.* Order Number DE89613806/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

Radon decay products, air temperature gradients and wind velocity have been measured in spring 1985 as well as in autumn and winter 1985/86 in four Swiss dwellings. Two of them are in a region of low natural radioactivity (limestone, Northern Jura), the other two in a high background area (granite, Central Alps). The mean annual lung exposure of the inhabitants in the first group is 1,2-2,2 WLM; the limit recommended by ICRP for uranium mines being 5 WLM. The dose equivalent is 10 mSv. In the other group the corresponding values are 20 WLM and 110 mSv. Data on the distribution of radon products over the houses as well as seasonal variations are given. 6 refs., 4 figs., 5 tabs. (qui).

34439 (OEVS-Mitteilung–1988, pp. 209-211) **Investigation of radiation exposure in Greek radon therapy centers and in Athens residences.** Kritidis, P. (National Research Centre for the Physical Sciences Democritos, Athens (Greece)); Angelou, P.; Pournis, S.; Tsiapali, A. Oesterreichischer Verband fuer Strahlenschutz (OeVS), Vienna (Austria). Nov 1988. (CONF-860969–: 4. European congress and 13. regional congress of the International Radiation Protection Association, Salzburg, Austria, 15-19 Sep 1986). In *4. European congress and 13. regional congress of IRPA. 20 years experience in radiation protection - a review and outlook.* Order Number DE89613806/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

The concentrations of the short-lived decay products of ^{222}Rn in air have been determined in nine Greek radon therapy centers as well as in a number of Athens residences. The resulting annual effective dose equivalents have been estimated. 6 refs., 1 tab.

34440 (OEVS-Mitteilung–1988, pp. 212-215) **Radon in dwellings - sources and entrance paths into houses and methods of radon concentration reduction.** Keller, G. (Universitaet des Saarlandes, Homburg/Saar (Germany, F.R.). Inst. fuer Biophysik). Oesterreichischer Verband fuer Strahlenschutz (OeVS), Vienna (Austria). Nov 1988. (In German). (CONF-860969–: 4. European congress and 13. regional congress of the International Radiation Protection Association, Salzburg, Austria, 15-19 Sep 1986). In *4. European congress and 13. regional congress of IRPA. 20 years experience in radiation protection - a review and outlook.* Order Number DE89613806/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

Average radon concentrations in buildings range over more than two orders of magnitude. The highest contribution to radiation exposure to the population from natural sources is due to inhalation of short-lived radon daughters. The median Radon-222 concentration in German buildings was found to be 40 Bq/m^3 (about 10 Bq/m^3 for Radon-220). The median equilibrium factor was determined as F=0,3 indoors. A maximum Radon-222 concentration of about 1250 Bq/m^3 was measured in a house built in 1925. Although radon exhalation from building materials represents the main source of median radon concentration in buildings, exhalation from the soil is the predominant source in cases of high indoor radon concentration. The results of our investigations on radon exhalation and diffusion in different materials and their dependence on influencing parameters are presented. Simple architectural methods to reduce radon in the soil entering buildings are put forward and their effectiveness is discussed with reference to the 'action level' for equilibrium equivalent radon concentrations in houses, recommended by ICRP publication No. 39. 5 refs., 2 figs.

34441 (OEVS-Mitteilung–1988, pp. 308-313) **Atmospheric concentration measurements of Kr-85. A tool for ecological standards.** Eggermont, G.X. (Ghent Rijksuniversiteit (Belgium). Lab. voor Kernfysica); Buysse, J.; Berkvens, P.; Raes, F. Oesterreichischer Verband fuer Strahlenschutz (OeVS), Vienna (Austria). Nov 1988. (CONF-860969–: 4. European congress and 13. regional congress of the International Radiation Protection Association, Salzburg, Austria, 15-19 Sep 1986). In *4. European congress and 13. regional congress of IRPA. 20 years experience in radiation protection - a review and outlook.* Order Number DE89613806/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

A survey is presented of accurate ground-level atmospheric concentration measurements of Kr-85 in Gent (Be) from 1979 to 1986,5 including post Chernobyl data. The background concentration on 1/7/86 was 0,86 Bq/m^3. These data are compared to a comprehensive recent analysis of published data before 1984 and to recent measurements in Europe, showing an actual inventory of Kr-85 of 3,1 EBq. A prognosis is made on Kr-85 pollution characteristics till 2000, illustrating the great interest of a coordinated international program of measurements and of geographic and quantitative backtracing. The laboratory is situated in the prevailling wind direction of the largest krypton source in the world, La Hague (Fr). Precise sensitive Kr-85 measurements offer an important tool for dispersion and transport studies and particularly for release and proliferation control. Release data on civil reprocessing should be reported daily. Dosimetric considerations support limited changes to ICRP methods of developing derived limits, taking into account stochastic effects in skin and lung. However, the Kr-85 pollution expected for the next decades, has no relevant radiological consequences (1,5 10E-6 Sv global skin dose expected in 2000). A possible synergism of ionising radiation with UV in the chemical transformation of SO2 was illustrated at laboratory scale. Extrapolated conclusions to the real atmosphere concerning acidification should not yet been drawn. Further effect studies regarding local accidental release plumes are worth considering. This problem could question an ICRP axiom that mankind is sufficiently protected if radiological protection of man is achieved. 16 refs., 2 figs.

34442 (OEVS-Mitteilung–1988, pp. 729-734) **Radioactivity in the Federal Republic of Germany and in Switzerland after the Chernobyl accident. Results of data collection by the working group Environment Monitoring.** Winter, M. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Hauptabteilung Sicherheit); Meyer, P.; Voelkle, H.; Narrog, J.; Kirchhoff, K. Oesterreichischer Verband fuer Strahlenschutz (OeVS), Vienna (Austria). Nov 1988. (In German). (CONF-860969–: 4. European congress and 13. regional congress of the International Radiation Protection Association, Salzburg, Austria, 15-19 Sep 1986). In *4. European congress and 13. regional congress of IRPA. 20 years experience in radiation protection - a review and outlook.* Order Number DE89613806/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

4The working group Environment Monitoring of the Federal Republic of Germany and of Switzerland decided in an extraordinary session on June 19 and 20, 1986 to perform - by its members - a collection of contamination values covering the two countries. Results on iodine 131 and cesium 137 activities of air, milk and grass at 4 sites in Switzerland and 12 sites in the FRG in the period of April 28 to June 20 of 1986 are listed in tables. 1 fig., 2 tabs. (qui).

34443 (OEVS-Mitteilung–1988, pp. 781-785) **Activity levels in air and ground in the region of Bremen after the Chernobyl accident.** Baumgartner, D. (Bremen Univ. (Germany, F.R.)); Fischer, H.; Goedecke, R.; Herzer, W.; Hettwig, B.; Kirchner, G.; Moser, D.; Urbach, M.; Schmitz-Feuerhake, I.; Wellner, R. Oesterreichischer Verband fuer Strahlenschutz (OeVS), Vienna (Austria). Nov 1988. (CONF-860969–: 4. European congress and 13. regional congress of the International Radiation Protection Association, Salzburg, Austria, 15-19 Sep 1986). In *4. European congress and 13. regional congress of IRPA. 20 years experience in radiation protection - a review and outlook.* Order Number DE89613806/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

Since April 30, 1986 the Chernobyl radioactivity reaching the region of Bremen has been followed up in air, ground and food. Here we present data on time-dependent radioactivity concentrations in air and on nuclide-specific concentrations deposited on ground by rain. Soil profiles show that up to now Cs from the Chernobyl reactor is fixed mainly in the upper 2,5 cm. In contrast to some higher contaminated areas in Southern Germany concentrations of long-lived Cs isotopes from Chernobyl fallout in soils in the region of Bremen are comparable to those originating from atomic weapons fallout of the Sixties. 4 refs., 4 figs., 2 tabs.

34444 (OEVS-Mitteilung–1988, pp. 791-798) **Post-Chernobyl environment monitoring data of nuclear power plants in Switzerland.** Cartier, F. (Hauptabteilung fuer die Sicherheit der Kernanlagen, Wuerenlingen (Switzerland)); Czarnecki, J.; Schuler, J. Oesterreichischer Verband fuer Strahlenschutz (OeVS), Vienna (Austria). Nov 1988. (In German). (CONF-860969–: 4. European congress and 13. regional congress of the International Radiation Protection Association, Salzburg, Austria, 15-19 Sep 1986). In *4. European congress and 13. regional congress of IRPA. 20 years*

experience in radiation protection - a review and outlook. Order Number DE89613806/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

TLD readings from the environment monitoring of 4 Swiss nuclear power plants were interpreted by the method of site-specific parameters. The net dose in the second quarter of 1986 attributable to the Chernobyl fallout, was around the nuclear power plant number: 1: 6,6±1 mrem; 2: 8,1±1 mrem; 3: 2,8±1 mrem; 4: 7,8±5 mrem. The net doses of particular measuring stations scattered by a factor of 3. The site-specific parameter method turns out to be suitable for interpretation not only of contamination with a strongly confined wind direction but also for a large-area contamination. 2 refs., 5 figs., 1 tab.

34445 (OEVS-Mitteilung–1988, pp. 808-812) **Consequences in Finland of the Chernobyl accident.** Rahola, T. (Finnish Centre for Radiation and Nuclear Safety, Helsinki (Finland)). Oesterreichischer Verband fuer Strahlenschutz (OeVS), Vienna (Austria). Nov 1988. (CONF-860969–: 4. European congress and 13. regional congress of the International Radiation Protection Association, Salzburg, Austria, 15-19 Sep 1986). In *4. European congress and 13. regional congress of IRPA. 20 years experience in radiation protection - a review and outlook.* Order Number DE89613806/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

Data on the geographic distribution of iodine 131- and cesium 137 in 1986 over Finland; on average values of the same deposits on several European countries; iodine 131- and cesium 137 activities in tourists returning to Finland from different countries including USSR; estimated doses from intake of particular foods as well as an estimation of the integral dose, due to the Chernobyl accident, are given. 1 ref., 2 figs., 3 tabs. (qui).

34446 (OEVS-Mitteilung–1988, pp. 817-820) **Some measurements of air radioactivity at the Gesellschaft fuer Schwerionenforschung in Darmstadt (FRG).** Festag, J.G. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Oesterreichischer Verband fuer Strahlenschutz (OeVS), Vienna (Austria). Nov 1988. (In German). (CONF-860969–: 4. European congress and 13. regional congress of the International Radiation Protection Association, Salzburg, Austria, 15-19 Sep 1986). In *4. European congress and 13. regional congress of IRPA. 20 years experience in radiation protection - a review and outlook.* Order Number DE89613806/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

Measurements of the β- and nuclide specific activity of 'Chernobyl'-aerosoles are shown. 2 figs., 1 tab.

34447 (OEVS-Mitteilung–1988, pp. 821-825) **Radionuclide composition of Chernobyl fallout at Munich.** Hoetzl, H. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.)); Rosner, G.; Winkler, R. Oesterreichischer Verband fuer Strahlenschutz (OeVS), Vienna (Austria). Nov 1988. (CONF-860969–: 4. European congress and 13. regional congress of the International Radiation Protection Association, Salzburg, Austria, 15-19 Sep 1986). In *4. European congress and 13. regional congress of IRPA. 20 years experience in radiation protection - a review and outlook.* Order Number DE89613806/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

It appears that the region of Southern Bavaria in the Federal Republic of Germany has received one of the highest depositions of Chernobyl fallout nuclides in Europe. The radionuclide composition of this fallout, including actinide nuclides, and the variation of activity deposition to the ground and of activity concentration in the ground level air with time are reported. Data were measured at the site of the Gesellschaft fuer Strahlen- und Umweltforschung (GSF) at Neuherberg, 10 km north of Munich. 6 refs., 3 figs., 3 tabs.

34448 (OEVS-Mitteilung–1988, pp. 826-827) **Radioactivity measurements after the reactor accident of Chernobyl.** Rank, D. (Bundesversuchs- und Forschungsanstalt Arsenal, Vienna (Austria)); Kurcz, I.; Maringer, F.J.; Nussbaumer, W. Oesterreichischer Verband fuer Strahlenschutz (OeVS), Vienna (Austria). Nov 1988. (In German). (CONF-860969–: 4. European congress and 13. regional congress of the International Radiation Protection Association, Salzburg, Austria, 15-19 Sep 1986). In *4. European congress and 13. regional congress of IRPA. 20 years experience in radiation protection - a review and outlook.* Order Number DE89613806/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

A sample of measurements by the Bundesversuchs- und Forschungsanstalt Arsenal, Vienna, Austria, on the consequences of radioactivity release from Chernobyl is presented. The measurements served partly to radioactivity control in food and environment, partly for documentation of the event as basis for later applications of this unintended marking of the environment. 4 figs.

34449 (OEVS-Mitteilung–1988, pp. 838-841) **Analyzes of Chernobyl fall-out made at Loviisa nps, Finland.** Wahlstroem, B. (Imatran Voima Oy, Loviisa nuclear power station, Loviisa (Finland)). Oesterreichischer Verband fuer Strahlenschutz (OeVS), Vienna (Austria). Nov 1988. (CONF-860969–: 4. European congress and 13. regional congress of the International Radiation Protection Association, Salzburg, Austria, 15-19 Sep 1986). In *4. European congress and 13. regional congress of IRPA. 20 years experience in radiation protection - a review and outlook.* Order Number DE89613806/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

At the Loviisa nuclear power plants measurements of activity concentrations of several radionuclides in air, in rain water and in the soil were performed on April 28, 1986 (reference levels), on April 29 after the first rain, two days and two weeks after the first rain. The nuclides were Mo 99, I 131, Te 132, I 133, Ru 103, Cs 134, Cs 136, Cs 137, Ba 140, Ce 141, Np 239 and Zr 95. Dose rates outdoors are given for April to September, as well as the additional dose for April 1 to June 30 due to Chernobyl at 9 different measuring points. 1 fig., 5 tabs. (qui).

34450 (OEVS-Mitteilung–1988, pp. 855-859) **Measurement of environmental radioactivity around Mainz (FRG) after the Chernobyl reactor accident.** Denschlag, H.O. (Mainz Univ. (Germany, F.R.). Inst. fuer Kernchemie); Diel, A.; Heimann, R.; Herrmann, G.; Kaffrell, N.; Menke, H.; Trautmann, N.; Weber, M. Oesterreichischer Verband fuer Strahlenschutz (OeVS), Vienna (Austria). Nov 1988. (In German). (CONF-860969–: 4. European congress and 13. regional congress of the International Radiation Protection Association, Salzburg, Austria, 15-19 Sep 1986). In *4. European congress and 13. regional congress of IRPA. 20 years experience in radiation protection - a review and outlook.* Order Number DE89613806/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

Radioactivity measurements on aerosols and in rain have been done soon after the Chernobyl accident, and analyzed with regard to the content of radionuclides. The percentages are similar in general, but the content of iodine in rain is higher, the content of barium and cesium lower than in aerosols. Comparing the composition of radionuclides in the fallout with that of the Chernobyl reactor it is seen that elements and their oxides and halogenides of high volatility prevail in the fallout. The content in soils of ^{90}Sr, ^{239}Pu and ^{226}Ra which accumulate in the human body on one hand, and of ^{137}Cs and ^{40}K as from Chernobyl is given and compared with the natural level and nuclear weapon tests contribution. The largest contribution from Chernobyl is with ^{137}Cs. 1 ref., 1 fig., 2 tabs. (qui).

34451 (OEVS-Mitteilung–1988, pp. 860-864) **Radiation and radioactivity levels in Hungary following the Chernobyl accident.** Sztanyik, L.B. ('Frederic Joliot-Curie' National Research Institute for Radiobiology and Radiohygiene, Budapest (Hungary)); Kanyar, B.; Koeteles, G.J.; Nikl, I.; Stur, D. Oesterreichischer Verband fuer Strahlenschutz (OeVS), Vienna (Austria). Nov 1988. (CONF-860969–: 4. European congress and 13. regional congress of the International Radiation Protection Association, Salzburg, Austria, 15-19 Sep 1986). In *4. European congress and 13. regional congress of IRPA. 20 years experience in radiation protection - a review and outlook.* Order Number DE89613806/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

The release of radioactive material due to the serious accident of the Chernobyl nuclear power station has contaminated several parts of Hungary. The atmospheric contamination arrived in three phases, a larger and two smaller ones reached the country on the night of Apr 29, May 3 and 6-8, respectively. Data most important to assess the dose received by members of the population are presented, i.e. radioactivity of the aerosol, external gamma-dose rate, contamination level on grass and in milk samples. These data were collected

by the radiological controlling and data providing network of the ministry of health. 1 ref., 5 figs.

34452 (OEVS-Mitteilung–1988, pp. 865-869) **Arrival of the Chernobyl cloud as detected by nation-wide monitoring network based on Geiger-Mueller counters.** Krueger, E.H. (Umweltinstitut Muenchen, Muenchen (Germany, F.R.)). Oesterreichischer Verband fuer Strahlenschutz (OeVS), Vienna (Austria). Nov 1988. (In German). (CONF-860969–: 4. European congress and 13. regional congress of the International Radiation Protection Association, Salzburg, Austria, 15-19 Sep 1986). In *4. European congress and 13. regional congress of IRPA. 20 years experience in radiation protection - a review and outlook.* Order Number DE89613806/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

A nation-wide monitoring system based on Geiger counter and anticoincidence technique indicated the arrival of the Chernobyl cloud in an early state. Warnings could be given to users of the system and the public. The way of the cloud over the Federal Republic of Germany was followed. Histograms of the γ-dose rate resulting from airborne and deposited radioactivity are given for five places in the Federal Republic. 4 figs.

34453 (OEVS-Mitteilung–1988, pp. 902-904) **Natural radioactivity and Chernobyl-fallout in the granite area of Fichtelgebirge (FRG).** Sansoni, B. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Zentralabteilung fuer Chemische Analysen); Matthes, W.; Kaysser, B.; Brunner, W. Oesterreichischer Verband fuer Strahlenschutz (OeVS), Vienna (Austria). Nov 1988. (CONF-860969–: 4. European congress and 13. regional congress of the International Radiation Protection Association, Salzburg, Austria, 15-19 Sep 1986). In *4. European congress and 13. regional congress of IRPA. 20 years experience in radiation protection - a review and outlook.* Order Number DE89613806/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

The granite area covers about 40% of the Fichtel mountains. Fallout after the Chernobyl accident has been measured in grass, soil, red-currant, mushroom, rowan and elderberry samples. From the single gamma nuclide activities, total gamma activities, relative single nuclide activities and activity ratios were calculated. Natural radioactivity was compared to the Chernobyl fallout. 2 refs. (qui).

34454 (OEVS-Mitteilung–1988, pp. 905-909) **Selected examples of the vegetation- and milk contamination as well as of spatial distribution of gamma dose rates in Bavaria, FRG.** Eder, E. (Bayerisches Landesamt fuer Umweltschutz, Muenchen (Germany, F.R.)). Oesterreichischer Verband fuer Strahlenschutz (OeVS), Vienna (Austria). Nov 1988. (In German). (CONF-860969–: 4. European congress and 13. regional congress of the International Radiation Protection Association, Salzburg, Austria, 15-19 Sep 1986). In *4. European congress and 13. regional congress of IRPA. 20 years experience in radiation protection - a review and outlook.* Order Number DE89613806/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

There is no text at all. Graphs are presented on the temporal development of milk- and vegetation contamination from April 29 to June 30, 1986, as well as a map of dose rate distribution in Bavaria. 4 figs. (qui).

34455 Accuracy of some simple models for predicting particulate interception and retention in agricultural systems. Pinder, J.E. III (Savannah River Ecology Laboratory, Aiken, SC (USA)); McLeod, K.W.; Adriano, D.C. *Health Physics (USA),* 56(4): 441-450 (Apr 1989).

The accuracy of three radionuclide transfer models for predicting the interception and retention of airborne particles by agricultural crops was tested using Pu-bearing aerosols released to the atmosphere from nuclear fuel facilities on the U.S. Department of Energy's Savannah River Plant, near Aiken, SC. The models evaluated were: (1) NRC, the model defined in U.S. Nuclear Regulatory Guide 1.109; (2) FOOD, a model similar to the NRC model that also predicts concentrations in grains; and (3) AGNS, a model developed from the NRC model for the southeastern United States. Plutonium concentrations in vegetation and grain were predicted from measured deposition rates and compared to concentrations observed in the field. Crops included wheat, soybeans, corn and cabbage. Although predictions of the three models differed by less than a factor of 4, they showed different abilities to predict concentrations observed in the field. The NRC and FOOD models consistently underpredicted the observed Pu concentrations for vegetation. The AGNS model was a more accurate predictor of Pu concentrations for vegetation. Both the FOOD and AGNS models accurately predicted the Pu concentrations for grains.

5006 Regulations

Refer also to citation(s) 33646

51 ENVIRONMENTAL SCIENCES, TERRESTRIAL

Refer also to citation(s) 34437

34456 (OEVS-Mitteilung–1988, pp. 248-262) **Why there is no causal link between radioactivity release from nuclear power plants and damaged forests.** Loosli, H. (Bern Univ. (Switzerland). Physikalisches Inst.); Weiss, W. Oesterreichischer Verband fuer Strahlenschutz (OeVS), Vienna (Austria). Nov 1988. (In German). (CONF-860969–: 4. European congress and 13. regional congress of the International Radiation Protection Association, Salzburg, Austria, 15-19 Sep 1986). In *4. European congress and 13. regional congress of IRPA. 20 years experience in radiation protection - a review and outlook.* Order Number DE89613806/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

First the direct effects of natural and man-made (effluents from nuclear power plants) radioisotopes to the leaves and needles of trees are compared. The result is that even in the immediate neighbourhood of nuclear power plants the additional man-made doses is considerably lower than the natural dose and its variation. Second the synergetical effects via e.g. the ozone and ion concentrations are considered and again the natural sources are more important. Finally measurements of temporal variations of radioactivity of radon and ozone concentrations on two different sites are presented and do not lead to a causal link between radon and ozone. 11 refs., 4 figs., 2 tabs. (qui).

5101 Basic Studies

34457 (DP-MS–88-62) **Constraints on the formulation of ecological models and theories: Conservation laws and domain-specific rule bases.** Loehle, C.S. Savannah River Lab., Aiken, SC (USA). 1988. 27p. Sponsored by DOE Defense Programs. DOE Contract AC09-76SR00001. Order Number DE89014083/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

There are various constraints that a well formed model or theory must obey to be error-free. Conservation laws include conservation of energy and mass, dimensional homogeneity, and conservation of information. Logical constraints such as non-negativity can be applied. Domain specific knowledge can also be useful. Models that violate these constraints are almost certainly incorrect, though meeting all of the constraints does not guarantee correctness. Implementation of these rules is discussed. Some rules are easily incorporated into conventional models, while others require more advanced programming approaches. A stand-alone model for dimensional analysis was developed and is discussed. Some types of constraints such as conservation laws are shown to have a potential role in uncovering new theory. 48 refs.

34458 (LA-UR–89-1305) **Modeling of the angular reflectance of an artificial plant canopy near the retroreflection peak in the optical regime.** Borel, C.C.; Powers, B.J.; Gerstl, S.A.W. Los Alamos National Lab., NM (USA). Apr 1989. 3p. DOE Contract W-7405-ENG-36. (CONF-890768–3: International geoscience and remote sensing symposium, Vancouver, Canada, 10-14 Jul 1989). Order Number DE89011174/JAW. Available from NTIS, PC A02/MF A01 - OSTI.

The narrow intensity peak in the reverse solar direction, also called the canopy hot spot or Heiligenschein, is studied using a artificial canopy. Polar Fourier analysis is proposed to classify asymmetric peaks for various canopy architectures. 5 refs., 4 figs.

34459 (PB–89-855894/XAB) **Ecosystem models. May 1983-April 1986 (Citations from the NTIS data base). Report for May 1983-April 1986.** National Technical Information Service, Springfield, VA (USA). Feb 1989. 147p. Available from NTISPC N01/MF N01.

See also PB–89-855902.

This bibliography contains citations concerning the design and application of ecosystem models. Ecosystem simulation and characterization models are included. Models for marine biology, plants, microorganisms, and food chains are given. Models that assess the effect of pollutants on specific environments are presented. Many habitat suitability index models are included in this bibliography. (This updated bibliography contains 311 citations, none of which are new entries to the previous edition.)

34460 (PB–89-855902/XAB) **Ecosystem models. May 1986-January 1989 (Citations from the NTIS data base). Report for May 1986-January 1989.** National Technical Information Service, Springfield, VA (USA). Feb 1989. 49p. Available from NTISPC N01/MF N01.

Supersedes PB–86-868270. See also PB–89-855894.

This bibliography contains citations concerning the design and application of ecosystem models. Ecosystem simulation and characterization models are included. Models for marine biology, plants, microorganisms, and food chains are given. Models that assess the effect of pollutants on specific environments are presented. Many habitat suitability index models are included in this bibliography. (This updated bibliography contains 72 citations, all of which are new entries to the previous edition.)

5102 Chemicals Monitoring and Transport

Refer also to citation(s) 33326, 34386, 34432, 34468, 34487, 34490, 34500

34461 (CONF-890526–1) **In situ venting of jet fuel-contaminated soil.** Elliott, M.G.; DePaoli, D.W. Oak Ridge National Lab., TN (USA). 1989. 19p. Sponsored by Department of Defense. DOE Contract AC05-84OR21400. From 44. annual Purdue industrial waste conference; West Lafayette, Indiana, USA; 9-11 May 1989. Order Number DE89014757/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The Air Force Engineering and Services center is performing a field demonstration of in situ soil venting at a 27,000-gallon jet fuel spill site at Hill AFB UT. In situ soil venting is a soil cleanup technique which uses vacuum blowers to pull large volumes of air through contaminated soil. The air flow sweeps out the soil gas, disrupting the equilibrium existing between the contaminants on the soil and in the vapor. This causes volatilization of the contaminants and subsequent removal in the air stream. In situ soil venting has been used for removing volatile contaminants such as gasoline and trichloroethylene, but a full-scale demonstration for removing jet fuel from soil has not been reported. This paper describes our initial site characterization, the one-vent pilot test, and the design and preliminary results of our full-scale in situ soil venting system. 5 refs., 7 figs.

34462 (LBL–27031) **A new approach to tracer transport analysis: From fracture systems to strongly heterogeneous porous media.** Tsang, Chin-Fu. Lawrence Berkeley Lab., CA (USA). Feb 1989. 25p. Sponsored by DOE Radioactive Waste Management. DOE Contract AC03-76SF00098. (CONF-8902109–1: International workshop on appropriate methodologies for development and management of groundwater resources in developing countries, Hyderabad, India, 28 Feb - 4 mar 1989). Order Number DE89012848/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Many current development and utilization of groundwater resources include a study of their flow and transport properties. These properties are needed in evaluating possible changes in groundwater quality and potential transport of hazardous solutes through the groundwater system. Investigation of transport properties of fractured rocks is an active area of research. Most of the current approaches to the study of flow and transport in fractured rocks cannot be easily used for analysis of tracer transport field data. A new approach is proposed based on a detailed study of transport through a fracture of variable aperture. This is a two-dimensional strongly heterogeneous permeable system. It is suggested that tracer breakthrough curves can be analyzed based on an aperture or permeability probability distribution function that characterizes the tracer flow through the fracture. The results are extended to a multi-fracture system and can be equally applied to a strongly heterogeneous porous medium. Finally, the need for multi-point or line and areal tracer injection and observation tests is indicated as a way to avoid the sensitive dependence of point measurements on local permeability variability. 30 refs., 15 figs.

34463 (ORNL/TM–11108) **Structure-activity relationships for the degradation of a mixture of organic chemicals in soil.** Anderson, T.A.; Walton, B.T. Oak Ridge National Lab., TN (USA). May 1989. 64p. Sponsored by Environmental Protection Agency. DOE Contract AC05-84OR21400. Order Number DE89013761/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

Submitted to Univ. of Tennessee, Knoxville.

The degradation rates of a mixture of volatile and semi-volatile organic compounds (N = 16) were determined by monitoring the removal of parent chemicals from two different soil types, a Captina silt loam (Typic Fragiudult) and a McLaurin sandy loam (Typic Paleudults), over a 7-day period. The compounds were applied to the soil in a mixture such that the concentration of each individual chemical was 100 μg/g soil (dry weight). Soil samples, along with sterile (autoclaved) controls, were incubated in the dark at 20°C in 8 × 5-cm glass jars equipped with teflon-lined stoppers and charcoal traps. Samples were disassembled, extracted with methanol, and analyzed on days 0, 2, 3, 6, and 7 of the experiment. Linear regression analysis was used to model the disappearance of the compounds from the soils. First-order degradation rate constants and half-lives were calculated. half-lives for the 16 organic compounds were relatively short (<23 days). Correlations between physicochemical parameters and half-lives were poor ($r \leq 0.63$) for the entire data set (N = 16), however, a group of structurally related benzene derivatives (N = 7) gave good correlations in both soil types with $\log_{10}$ octanol-water partition coefficient ($r \geq 0.89$), $\log_{10}$ molecular weight ($r \geq 0.84$), $\log_{10}$ water solubility ($r \geq 0.77$), and molecular connectivity ($r \geq 0.83$). 81 refs., 3 figs., 13 tabs.

34464 (PB–89-138473/XAB) **Impacts of acidic deposition: context and case studies of forest soils in the southeastern US.** Binkley, D.; Driscoll, C.T.; Allen, H.L.; Schoeneberger, P.; McAvoy, D. Colorado State Univ., Fort Collins, CO (USA). Dept. of Forest and Wood Sciences. Dec 1988. 189p. Available from NTIS, PC A09/MF A01.

The authors designed their assessment to include both the basic foundation needed by non-experts and the detailed information needed by experts. Their assessment includes background information on acidic deposition (Chap. 1), an in-depth discussion of the nature of soil acidity and ecosystem H(1+) budgets (Chap. 2), and a summary of rates of deposition in the Southeastern U.S. (Chap. 3). A discussion of the nature of forest soils in the region (Chap. 4) is followed by an overview of previous assessments of soil sensitivity to acidification (Chap. 5). The potential impacts of acidic deposition on forest nutrition are described in the context of the degree of current nutrient limitation on forest productivity (Chap. 6). The results of simulations with the MAGIC model provided evaluations of the likely sensitivity of a variety of soils representative of forest soils in the South (Chap. 7), as well as a test of soil sensitivity criteria. The authors' synthesis and recommendations for research (Chap. 8) also serve as an executive summary.

34465 (PB–89-149306/XAB) **Risk assessment models for land application of municipal sludges (RAMMS Version 3.0). Volume 1. Draft complete documentation of the system/user manual.** Science Applications International Corp., McLean, VA (USA). 1989. 104p. Available from NTIS, PC A06/MF A01.

For system on diskette, see PB–89-138739.

The U.S. Environmental Protection Agency (EPA) has developed a series of models for calculating the risks associated with the land

application of municipal sludge. These models were used in the development of the Proposed Technical Sludge Regulation, and have been collected together in a single, user-friendly computer program. The manual contains a basic description of the risk-assessment models, explains how to use the computer program, and documents the code, input, and output data for the program. The manual is organized in six chapters. The first chapter is a brief description of the risk-assessment models as they are implemented by the program. The second chapter explains system requirements and how to install the program on appropriate systems. The third chapter explains how the program is structured and outlines options that can be invoked at different stages of execution. The fourth chapter steps through typical execution of the program, showing input screens and output screens that are encountered. The fifth chapter is the listing of the program code, and the sixth chapter is a listing of data files used by the program.

34466 (PB–89-855993/XAB) **Polychlorinated biphenyls: occurrence in sediments and soils. January 1977-February 1989 (Citations from the Selected Water Resources Abstracts data base). Report for January 1977-February 1989.** National Technical Information Service, Springfield, VA (USA). Feb 1989. 158p. Available from NTISPC N01/MF N01.

Supersedes PB–88-857123.

This bibliography contains citations concerning field and laboratory analyses of polychlorinated biphenyls in sediments and soils. Topics include site studies, chemical analyses of adsorption-desorption processes, decomposition in soils, including biodegradation, and bioaccumulation. Detection methods and equipment, and the impact of dredging in contaminated areas are also discussed. (This updated bibliography contains 249 citations, 42 of which are new entries to the previous edition.)

5103 Radioactive Materials Monitoring and Transport

Refer also to citation(s) 33266, 33327, 33328, 33412, 33573, 34098, 34376, 34442, 34443, 34445, 34447, 34449, 34450, 34453, 34505, 34700

34467 (BFR-R–88-1988) **Radon I dwellings. Testing and evaluation of constructional and buildings services engineering measures.** Ericson, S.O.; Nilsson, I.; Schmied, H. Swedish Council for Building Research, Stockholm (Sweden). 1988. 187p. (In Swedish). Order Number DE89617961/JAW. Available from NTIS (US Sales Only), PC A09/MF A01 - OSTI; INIS.

This report sets out the results of projects on remedial measures against radon. Previous and present results have been collated to provide a guide to the source and entry paths of radon. Account has been taken of the effect of external factors on the emission of radon by building materials and of the paths taken by radon in both the soil and buildings. Within the project, different measures taken in existing and newly constructed buildings to reduce the radon content have been tested and evaluated. The radon/radon daughter content has been measured before and after remedial measure in existing buildings and after the construction of new buildings. The buildings included in this survey have high radon daughter contents or are situated on soil with high radon levels. The durability of the measures has been checked 1-5 years after application. The durability of the measures has been mostly satisfactory. (With 47 refs.) (authors).

34468 (EML–519) **The EML soil inventory and archive.** Klusek, C.S. Department of Energy, New York, NY (USA). Environmental Measurements Lab. Apr 1989. 97p. Sponsored by DOE Energy Research. Order Number DE89013159/JAW. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

In 1953, the Environmental Measurements Laboratory (formerly the Health and Safety Laboratory, then part of the USAEC) began a systematic program to measure ^{90}Sr in soil through a cooperative effort with the US Department of Agriculture's Soil Conservation Service at its Beltsville Soil Laboratory in Maryland. This effort marked the beginning of the Laboratory's use of soil sampling to study radionuclide deposition that would continue to the present time. As recently as 1986, samples were collected in 11 locations in Europe to study fallout following the Chernobyl nuclear reactor accident. In the 35 years since the first samples were collected, nearly 5000 soil samples have been collected and analyzed. Since these soil samples represent a valuable resource for the chronological study of natural fallout radionuclides and other pollutants in the environment, we have undertaken to catalogue them. These samples represent one of several types of natural matrix samples which comprise the Laboratory's Samples Archive. There are currently a total of nearly 50,000 samples in the archive, including lake sediments, atmospheric dust, seawater, bone ash, and diet ash samples. This report is comprised of two sections, Section 1 describes the inventory database and access system, and the samples available in the archive. In Section 2, Historic Overview, a short discussion for each of the various soil sampling programs is presented. 74 refs.

34469 (IAEA-TECDOC–494) **Radioactive fallout in food and agriculture. A background review for the FAO Standing Committee on Radiation Effects, the FAO Land and Water Development Division, and the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture.** Winteringham, F.P.W. International Atomic Energy Agency, Vienna (Austria). Jan 1989. 84p. Order Number DE89618054/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

Part 1 of this review is designed to provide an up-dated background to the subject in relation to FAO's interests and responsibilities in scientifically accurate but non-technical language. Part 2 is concerned more specifically with the problems of radioactive fallout over pasture and cultivated soils. Moreover, it is mainly concerned with problems of international significance under peacetime conditions and which are likely only to arise as a result of a major nuclear reactor accident, or, possibly, some unintended nuclear explosion. However, relatively local problems of soil contamination could arise as a result of other kinds of accident. In the report the natural occurrence of radionuclides, and radiation exposure as a fact of life in the human environment, are indicated. Exposure to ionizing radiation from natural and man-made sources are compared. The behaviour and significance of radionuclides in ecosystems are briefly illustrated. Land-based nuclear power stations and nuclear-powered ships and submarines are identified as the major potential accident hazards to agriculture or fisheries under peacetime conditions. 216 refs, figs and tabs.

34470 (IC–89/16) **Natural selection and optimality.** Torres, J.L. International Centre for Theoretical Physics, Trieste (Italy). Jan 1989. 12p. Order Number DE89619867/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

It is assumed that Darwin's principle translates into optimal regimes of operation along metabolical pathways in an ecological system. Fitness is then defined in terms of the distance of a given individual's thermodynamic parameters from their optimal values. The method is illustrated testing maximum power as a criterion of merit satisfied in ATP synthesis. (author). 26 refs, 2 figs.

34471 (INIS-mf–11463) **Sheep monitoring programme January - September 1988.** Colgan, P.A.; Scully, B.J. Nuclear Energy Board, Dublin (Ireland). Feb 1989. 15p. Order Number DE89619840/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

This report summarises the work undertaken by the Board during the first nine months of 1988, and includes the results of in vivo farm measurements, slaughterhouse monitoring and butchers' shops surveys relating to sheep and sheepmeat.

34472 (INIS-mf–11465) **Monitoring of radioactivity in foodstuffs in Ireland 1987.** Nuclear Energy Board, Dublin (Ireland). Dec 1988. 87p. Order Number DE89619876/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

This report presents a compilation of the results of measurements made by the Board's laboratory during 1987, the year following the accident. When the level of Chernobyl deposition had been broadly established, the programme was concentrated on the foodstuffs of greatest interest and was supportive of the exportation of Irish foodstuffs. As well as testing food produce of Irish origin the Board also monitored food imports from abroad. Over 7500 samples were analysed and some 3000 certificates were issued for food exports.

34473 (OEVS-Mitteilung–1988, pp. 756-760) **Chernobyl fallout at Delft.** Vries, W. de (Interuniversitair Reactor Inst., Delft (Netherlands)); Kooij, A. van der; Bos, A.J.J.; Rasmussen, C.E. Oesterreichischer Verband fuer Strahlenschutz (OeVS), Vienna (Austria). Nov 1988. (CONF-860969–: 4. European congress and 13. regional congress of the International Radiation Protection Association, Salzburg, Austria, 15-19 Sep 1986). In *4. European congress and 13. regional congress of IRPA. 20 years experience in radiation protection - a review and outlook.* Order Number DE89613806/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

Radioactivity in air, grass and water due to the Chernobyl accident has been measured. Samples have been analysed with a Ge(Li) detector shielded from ambient background. Highest measured air concentrations in Bqm^{-3} were: ^{131}I: 18,2; $^{132}Te/^{132}I$: 19,9; ^{137}Cs: 5,0; ^{134}Cs: 3,2; ^{103}Ru: 5,1; ^{99}Mo: 1,8; $^{140}Ba/^{140}La$: 2,3. Maximum deposition densities in $kBqm^{-2}$ on grass varied from 3,6 (^{131}I), 0,8 ($^{132}Te/^{132}I$) and 0,4 (^{103}Ru) to 0,3 (^{137}Cs). In rain water the same radionuclides were found with a maximum ^{131}I-concentration on the 3rd of May: 1,4 $MBqm^{-3}$. The highest radioactivity was found in sludge taken from a spout. In this sample (48 Bqg^{-1}) 18 different radionuclides among which ^{110m}Ag, but no ^{239}Np, could be distinguished. Integrated total (dry and wet) deposition density has been estimated at 20 $kBqm^{-2}$. As a consequence of the Chernobyl fallout in the Delft region an (committed) effective dose equivalent for adults during the month of May 1986 of 0,02 mSv has been derived. 2 refs., 3 figs., 3 tabs.

34474 (OEVS-Mitteilung–1988, pp. 765-766) **Hot particles in the radioactive deposition in Greece after the Chernobyl accident.** Kritidis, P. (National Research Centre for the Physical Sciences Democritos, Athens (Greece)); Katsaros, N.; Angelou, P. Oesterreichischer Verband fuer Strahlenschutz (OeVS), Vienna (Austria). Nov 1988. (CONF-860969–: 4. European congress and 13. regional congress of the International Radiation Protection Association, Salzburg, Austria, 15-19 Sep 1986). In *4. European congress and 13. regional congress of IRPA. 20 years experience in radiation protection - a review and outlook.* Order Number DE89613806/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

A number of hot particles has been detected in the radioactive deposition in Greece after the Chernobyl accident. The results of their analysis by gamma-spectrometry are given. 1 tab.

34475 (OEVS-Mitteilung–1988, pp. 741-745) **Preliminary results on measurement of radioactivity deposited and washed-off.** Jacob, P. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.)); Meckbach, R.; Mueller, H. Oesterreichischer Verband fuer Strahlenschutz (OeVS), Vienna (Austria). Nov 1988. (In German). (CONF-860969–: 4. European congress and 13. regional congress of the International Radiation Protection Association, Salzburg, Austria, 15-19 Sep 1986). In *4. European congress and 13. regional congress of IRPA. 20 years experience in radiation protection - a review and ourlook.* Order Number DE89613806/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

After the Chernobyl accident gamma spectra at squares, courtyards, streets and meadows were taken in three sites in Upper Bavaria. It is found that most of the radioactivity coming from the thundershower of 30 04 1986 drained off the lined areas or was removed by the first street-cleaning. The portion still remaining decayed with 140 day half-life. On roof tiles the double radioactivity of lined areas was found. 3 refs., 3 figs., 2 tabs.

34476 (OEVS-Mitteilung–1988, pp. 799-801) **Radioactive burden in soil and milk around Oldenburg (FRG) in the wake of the Chernobyl accident.** Helmers, H. (Carl-von-Ossietzky Univ. Oldenburg, Fachbereich Physik, Oldenburg (Germany, F.R.)). Oesterreichischer Verband fuer Strahlenschutz (OeVS), Vienna (Austria). Nov 1988. (In German). (CONF-860969–: 4. European congress and 13. regional congress of the International Radiation Protection Association, Salzburg, Austria, 15-19 Sep 1986). In *4. European congress and 13. regional congress of IRPA. 20 years experience in radiation protection - a review and outlook.* Order Number DE89613806/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

The equipment and the measuring procedure of the radioactivity measuring station of the Oldenburg university are specified. Samples of results, i.e. contamination of milk and soil (with depth profiles) by cesium 134, cesium 137, ruthenium 103 and ruthenium 106 before and following the Chernobyl accidents are listed. The data are to be used for information of the public. 3 figs. (qui).

34477 (OEVS-Mitteilung–1988, pp. 772-775) **Radioactivity measurements around Graz, Austria.** Mueller, H. (Technische Univ., Graz (Austria). Inst. fuer Theoretische Physik und Reaktorphysik); Kahr, G.; Ninaus, W.; Oswald, K.; Rabitsch, H. Oesterreichischer Verband fuer Strahlenschutz (OeVS), Vienna (Austria). Nov 1988. (In German). (CONF-860969–: 4. European congress and 13. regional congress of the International Radiation Protection Association, Salzburg, Austria, 15-19 Sep 1986). In *4. European congress and 13. regional congress of IRPA. 20 years experience in radiation protection - a review and outlook.* Order Number DE89613806/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

The time-development of the integral activity of aerosols, rain water and grass are listed for the period 30 Apr - 10 Jun 1986. A sample composition of the radionuclides Te 132, J 131, Te 129^m, Ru 103, Mo 99, Cs 137, Ba 140, Ru 106, Cs 134, Cs 136, Zr 95 in grass as of 30 Apr and 13 May is also given. 2 figs., 2 tabs. (qui).

34478 (OEVS-Mitteilung–1988, pp. 813-816) **Chernobyl in the university town Muenster (FRG).** Schuetz, J. (Radiologische Universitaetsklinik Muenster, Muenster (Germany, F.R.)); Kronholz, H.L.; Marburger, H. Oesterreichischer Verband fuer Strahlenschutz (OeVS), Vienna (Austria). Nov 1988. (In German). (CONF-860969–: 4. European congress and 13. regional congress of the International Radiation Protection Association, Salzburg, Austria, 15-19 Sep 1986). In *4. European congress and 13. regional congress of IRPA. 20 years experience in radiation protection - a review and outlook.* Order Number DE89613806/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

Measurement of dose rates. Problems of community administration. 1 fig.

34479 (SKI–87132) **Nuclide solubilities and distribution coefficients for use in probabilistic modeling. Data for the nuclides ^{14}C, ^{79}Se, ^{93}Zr, ^{99}Tc, ^{126}Sn, ^{129}I, ^{135}Cs, ^{237}Np and ^{239}Np.** Andersson, K. Swedish Nuclear Power Inspectorate, Stockholm (Sweden). 15 Jan 1988. 27p. Order Number DE89617962/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

At the Swedish Nuclear Power Inspectorate (SKI) probabilistic modeling is studied as a means of safety analysis of disposal of high level radioactive waste. A version of the SYVAC code is used for this purpose. At this stage the conceptual model of the repository is the same as was used in the KBS-3 study, i.e. a repository situated in granitic rock at ca 500 m depth. The waste is encapsulated in copper, canisters and a bentonite clay backfill is applied around the canisters. In this report data for solubilities and distribution coefficients (K_d-values) for the nuclides ^{14}C, ^{79}Se, ^{93}Zr, ^{99}Tc, ^{126}Sn, ^{129}I, ^{135}Cs, ^{237}Np and ^{239}Np are discussed. Recommendations of ranges and distributions of data for use in the model are given. The choice of nuclides is made among the more long-lived nuclides in the waste. The available data for some of these nuclides are quite poor, and large ranges are therefore selected. The variational analysis of the complete transport model system will show if these data are of significant importance to the final result (=dose commitment) and need a further evaluation. For all data that have been assigned a range of values, a lognormal distribution has been assumed at this stage.

5106 Regulations

Refer also to citation(s) 34457

34480 (PB–89-135859/XAB) **Superfund exposure assessment manual.** Environmental Protection Agency, Washington, DC (USA). Office of Emergency and Remedial Response. Apr 1988. 166p. (EPA–540/1-88/001). Available from NTIS, PC A08/MF A01.

This Manual provides a framework for the assessment of exposure to contaminants at or migrating from uncontrolled hazardous-waste sites, covering the application of both monitoring

and modeling procedures to the exposure assessment process. This process considers all contaminant releases and exposure routes and assures that an adequate level of analytical detail is applied to support the human health risk-assessment process. The analytical process covers: analysis of contaminant releases from a subject site into environmental media; evaluation of the transport and environmental fate of the contaminants released; identification, enumeration, and characterization of potentially exposed populations; integrated exposure analysis; and uncertainty analysis. The manual supports the development of exposure assessments that are consistent from site to site, and provides a means of documenting that each site receives adequate evaluation.

34481 (PB–89-136576/XAB) **Land application and distribution and marketing of sewage sludge: technical support document.** Environmental Protection Agency, Washington, DC (USA). Office of Water Regulations and Standards. 1986. 514p. Available from NTIS, PC A22/MF A01.

This document provides the technical background and justification for the U.S. Environmental Protection Agency's (EPA) proposed regulation (40 CFR Part 503) covering the land application and distribution and marketing of sewage sludge. The document summarizes current practices in land application and presents data supporting the risk-assessment methodology used to derive human health and environmental risk-based limits for contaminants in land-applied sewage sludge. The underlying assumptions of the methodology, embodied in a series of computer models, are discussed, and the risk-based contaminant limits derived by the models are presented. The three management practices associated with land application are outlined, and the twelve different pathways by which contaminants reach most-exposed individuals through land application are discussed.

34482 (PB–89-136584/XAB) **Landfilling of sewage sludge: technical support document.** Environmental Protection Agency, Washington, DC (USA). Office of Water Regulations and Standards. 1989. 341p. Available from NTIS, PC A15/MF A01.

This document provides the technical background and justification for the U.S. Environmental Protection Agency's (EPA's) proposed regulation (40 CFR Part 503) covering the disposal of municipal sewage sludge in sludge-only landfills (monofills). The document summarizes current practices at monofills and presents the risk-assessment methodology used to derive human health and environmental risk-based limits for contaminants in monofilled sewage sludge. The underlying assumptions of the risk-assessment methodology, embodied in a series of computer models, are discussed, the values assigned to the model parameters are presented and justified, and the risk-based contaminant limits derived by the models are presented. The various siting limitations and management practices mandated by the regulation are discussed and justified.

34483 (PB–89-139018/XAB) **Are we cleaning up: 10 Superfund case studies; a special report of OTA's (Office of Technology Assessment's) assessment on Superfund implementation.** Office of Technology Assessment (U.S. Congress), Washington, DC (USA). Jun 1988. 87p. (OTA-ITE–362). Available from NTIS, PC A05/MF A01.

Also available from Supt. of Docs.; Library of Congress catalog card no. 88-600545.

This special report presents 10 case studies of recent Superfund decisions at sites representative of a broad range of contamination problems and cleanup technologies. The report assesses the impacts of statutory provisions and program policies on environmental effectiveness and economic efficiency.

34484 EPA proposes new standards for municipal solid waste disposal landfills. *JAPCA, International Journal of Air Pollution Control and Waste Management (USA),* 38(10): 1248 (Oct 1988).

The US Environmental Protection Agency on August 24 took its first major regulatory action to control the disposal of municipal garbage. In this effort, the agency proposed standards to upgrade the condition and help ensure the safety of municipal landfills used to dispose of solid waste. Under the proposal, states would use the standards to ensure protection of the environment from the operation of the landfills. In addition, landfill operators would be required to set up groundwater-monitoring systems and clean up contamination at operating landfills as well as close down within five years landfills located in unstable areas; landfills in some restricted areas would require special controls.

52 ENVIRONMENTAL SCIENCES, AQUATIC

5201 Basic Studies

Refer also to citation(s) 33372, 33373, 33374, 33375, 33377, 33378, 34459, 34460, 34488, 34511

34485 (AD-A–204461/8/XAB) **Installation-restoration program. Phase 2. Confirmation/quantification Stage 1 for Minot Air Force Base, Minot, North Dakota. Volume 1. Final report, September 1985-October 1988.** Hart (Fred C.) Associates, Inc., New York, NY (USA). 12 Oct 1988. 201p. Available from NTIS, PC A10/MF A01.

See also Volume 2, AD-A204 620.

In accordance with the procedures developed for the Department of Defense (DOD) Installation-Restoration Program (IRP), a Phase II, Stage I site investigation was performed at the Minot Air Force Base (MAFB), Minot, North Dakota. Fred C. Hart Associates (HART) conducted investigations at three areas of concern at the installation, the Sanitary Landfill Area (SLA), the Firefighting Training Area (FTA) and the Explosive Ordnance Disposal Area (EOD). The investigation of the SLA consisted of the installation and sampling of ground-water monitoring wells and of surface water within the SLA. The investigation of the FTA consisted of the installation and sampling of subsurface soil from a test boring drilled in the center of the FTA and the sampling of surface sediment within the drainage ditch leading away from the FTA.

34486 (NEI-NO–82, pp. 153-161) **Integrated effects on the compsitions of groundwater and surface water.** Paces, T. Norsk Hydrologisk Komite, Oslo (Norway). 1987. (CONF-870577–: International symposium on acidification and water pathways, Bolkesjo, Norway, 4-8 May 1987). In *Acidification and water pathways. Vol. 1. Proceedings of the International symposium on acidification and water pathways, Bolkesjoe, 4-5 May 1987.* Order Number DE89766881/JAW. Available from NTIS (US Sales Only), PC A20/MF A01.

The paper deals with the integrated impacts on the composition of ground water and surface water. The impacts concern the formation of chemical composition of meteoric geochemical and biochemical process affected today by anthropogenic activities. The natural systems of water pathways are described in order to understand the complexity of the interpretation of isotopic and chemical characteristics as consisting of various inputs, sources, sinks, and processes, 75 references.

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Refer also to citation(s) 33175, 33762, 33763, 34054, 34383, 34386, 34426, 34427, 34462, 34466, 34485, 34486, 34513

34487 (BNL–37144) **Nationwide review of oxygen depletion and eutrophication in estuarine and coastal waters: Executive summary.** Whitledge, T.E. Brookhaven National Lab., Upton, NY (USA). Sep 1985. 31p. Sponsored by DOE Energy Research. DOE Contract AC02-76CH00016. Order Number DE89012387/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The Status and Trends Program of the Ocean Assessment Division of the National Oceanic and Atmospheric Administration (NOAA) contracted with Brookhaven National Laboratory to assess the health of the estuarine and coastal environments in the US as indicated by low oxygen concentrations, eutrophication or mass mortalities of biological organisms. This intensive eutrophication or mass mortalities of biological organisms. This intensive but brief survey was accomplished through subcontracts to five regional investigators and represented the (1) Northeast, (2) Southeast, (3) Florida, (4) Gulf Coast, and (5) West Coast regions of the country. Each principal investigator was responsible for a subset of the 196 estuaries or embayments in his region. Additional information on other

contaminants were also included in the reports when such information was deemed important. An exhaustive search of all literature was not possible owing to the time and money constraints; however, significant data were located for most of the estuaries. 1 fig.

34488 (DPST–86-801) **Distribution and abundance of zooplankton at selected locations on the Savannah River and from tributaries of the Savannah River Plant: December 1984–August 1985.** Chimney, M.J.; Cody, W.R. Savannah River Lab., Aiken, SC (USA); Environmental and Chemical Sciences, Inc., Aiken, SC (USA). Nov 1986. 176p. Sponsored by DOE Defense Programs. DOE Contract AC09-76SR00001. (ECS-SR–41). Order Number DE89013168/JAW. Available from NTIS, PC A09/MF A01 - OSTI; GPO Dep.

Spatial and temporal differences in the abundance and composition of the zooplankton community occurred at Savannah River and SRP creek/swamp sampling locations. Stations are grouped into four categories based on differences in community structure: Savannah River; thermally influenced stations on Four Mile Creek and Pen Branch; closed-canopy stations in the Steel Creek system; and open-canopy Steel Creek stations, non-thermally influenced stations on Pen Branch and Beaver Dam Creek. Differences among stations were little related to water temperature, dissolved oxygen concentration, conductivity or pH at the tine of collection. None of these parameters appeared to be limiting. Rather, past thermal history and habitat structure seemed to be important controlling factors. 66 refs.

34489 (LBL–26438) **Hydrological, geochemical, and ecological characterization of Kesterson Reservoir: Annual report, October 1, 1987–September 30, 1988.** Lawrence Berkeley Lab., CA (USA); California Univ., Richmond, CA (USA). Sanitary Engineering Research Lab. Oct 1988. 229p. DOE Contract AC03-76SF00098. 8-AA-20-06330. Order Number DE89013414/JAW. Available from NTIS, PC A11/MF A01 - OSTI; GPO Dep.

Over the last year the ecological studies have focused on two areas, the wet and dry zones. The studies reported here are the latest results from the Pond 5E experiment, which has now been terminated, and the terrestrial food chain study, which has also been terminated. Although most of the data for these two projects have been collected and analyzed, there remain the last collections (September) to be fully analyzed. Tentative conclusions from the Pond 5E experiment indicate that the decline in selenium has continued for most biota. The decline, which commenced soon after the introduction of low-selenium water, has not been a smooth decline. The initial logarithmic decline has shown a definite seasonal cycling with the winter values being higher than those of summer. Most species are still apparently not in equilibrium with the selenium in their environment. The sources of selenium in Pond 5E are new (from the approximately 1.0 ppB in the groundwater supply) or recycled selenium (from extraction of plants and animals). Thus a continued declining trend is apparent for most, but not all, species. The final data points will allow calculation of the depuration kinetics for the final stages. 56 refs., 58 figs., 23 tabs.

34490 (NIVA-O–82073) **RAIN project. Annual report for 1987.** Wright, R.F. Norsk Inst. for Vannforskning, Oslo (Norway). May 1988. 81p. Order Number DE89776216/JAW. Available from NTIS (US Sales Only), PC A05/MF A01;1.

The RAIN project (Reversing acidification in Norway) is an international research project aimed at investigating the effect on water and soil chemistry of changing acid deposition to whole catchments. The results from 1987 represent 4 years of treatment from Sogndal and 3 1/2 years at Risdalsheia. The original 5-years project period will be extended an additional 3 years through June 1991. Sulfate concentrations have increased from about 20- 25 μeq/1 to 50-57 μeq/1 at SOG2 (H_2SO addition) and 35-45 μeq/1 at SOG4 (H_2SO_4 + HNO_3 addition). These levels are about 50% of the expected steady-state concentrations. Addition of HNO_3 has caused only minor increases in nitrate in runoff. At Risdalsheia acid-exclusion has resulted in lower concentrations of the strong acid anions NO_3 (from 35 to 7 μeq/1) and SO_4 (from 110 to 53 μeq/1) relative to both the roofed control catchment and open catchment. The input-output budgets indicate that the acid exclusion has reversed soil acidification at Risdalsheia. The effect of organic acids on the pH of runoff has increased in importance as the acid-exclusion experiment has proceeded. 23 figs., 29 tabs., 31 refs.

34491 (ORNL/FTR–3273) **[First international symposium on small estuaries, Primosten, Yugoslavia, May 19–28, 1989]: Foreign trip report.** Olsen, C.R. Oak Ridge National Lab., TN (USA). 4 Jun 1989. 14p. Sponsored by DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89014732/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The First International Symposium on Small Estuaries was organized to provide an opportunity for an international community of scientists to present and discuss results of their research on the biochemical processes that affect the fate of particles, nutrients, metals, and contaminants at the land-ocean interface. The traveler presented a paper at this symposium entitled, "Radioactive and Stable Isotope Tracers for Estuarine Processes and River-Ocean Exchange." Several of the presentations by French and Yugoslavian scientists focused on the Krka River estuary along the Adriatic coastline of Croatia, Yugoslavia. The Krka is a small and extensively studied salt-wedge estuary that is being used as a natural model for characterizing biochemical processes in large estuarine systems. The symposium ended with a final roundtable discussion concerning future estuarine research and international cooperation, in response to global climatic and environmental change. 2 refs.

34492 (PB–89-102545/XAB) **Abstracts of publications and presentations, 1985-1986.** Lockheed Engineering and Sciences Co., Inc., Las Vegas, NV (USA). Sep 1988. 81p. Available from NTIS, PC A05/MF A01.

In 1980, the U.S. Environmental Protection Agency (EPA) implemented the Aquatic Effects Research Program (AERP) as part of the National Acid Precipitation Assessment Program. This document contains information on publications and presentations authored or coauthored by AERP-EPA and contractor personnel in 1985 and 1986. Major activities during this time included field surveys in the National Surface Water Survey and the Direct/Delayed Response Project, pilot studies in the Episodic Response Project, and initiation of the Watershed Processes and Manipulation Project at Little Rock Lake, WI. Additionally, planning and design efforts were underway for other component projects, including the Watershed Manipulation Project, Regional Case Studies, and a long-term monitoring effort.

34493 (PB–89-138416/XAB) **Evaluation of control chart methodologies for RCRA (Resource Conservation and Recovery Act) waste sites.** Starks, T.H. Nevada Univ., Las Vegas, NV (USA). Environmental Research Center. Jan 1989. 49p. Available from NTIS, PC A03/MF A01.

This report is a discussion of decision rules relating to the monitoring of ground water at hazardous-waste sites that are subject to regulation under the Resource Conservation and Recovery Act of 1976 (RCRA). The final rule for RCRA regulations 40CFR part 264 was published October 1, 1988 (53FR39720). Understanding the complexity of the monitoring problem and the diversity of RCRA sites, the final rule wisely allows the owner/operator to choose, conditioned on EPA approval, a site-specific 'statistical procedure.' Particular attention is paid to the possible application of industrial quality-control strategies to the ground-water monitoring problem. A decision procedure that changes over time as more information about well and aquifer characteristics accumulate is proposed. This procedure involves the use of outlier tests and of Shewhart-CUSUM quality-control strategies.

34494 (PB–89-138432/XAB) **Eastern Lake Survey, Phase 1. Data base.** Lockheed Engineering and Sciences Co., Inc., Las Vegas, NV (USA). Sep 1988. 134p. Available from NTIS, PC A07/MF A01.

See also related magnetic tape, PB–87-193298.

This data base package, which covers only the first phase of ELS (ELS-I), represents one of several products produced by the Aquatic Effects Research Program Technical Information Project. A computerized copy of the ELS-I data set and the documentation necessary to make use of the data are included in the package. There are three distributed ELS-I data sets: data set 3, the validated data set; data set 4, the final data set; and a subset of data set 4 distributed on IBM personal computer (PC) format disks. Data sets 3 and 4 are distributed on magnetic tape, and the PC data set is distributed on a low-density diskette. Documentation provided in the data-base package includes a description of the design and implementation of ELS-I (Section 2), information on the statistical design of the survey

(Section 3), and a summary of survey results (Section 4). The data-base dictionary, instructions on accessing the data-base dictionary and instructions on accessing the data are included as appendices.

34495 (PB–89-138804/XAB) **Analysis of volatile organic compounds in water by dynamic stripping, thermal desorption, cryofocusing, and capillary gas chromatography (journal version).** Vandegrift, S.A. Northrop Services, Inc., Ada, OK (USA). 1988. 6p. Available from NTIS, PC A02/MF A01.

Pub. in Jnl. of Chromatographic Science, Vol. 26, 513-516(Oct 1988).

A dynamic headspace procedure developed for the determination of volatile organic compounds (VOCs) in water is described. The VOCs are purged from a water sample with an inert gas, transferring them to a tube packed with Tenax adsorbent. The adsorbent tube, or trap, is thermally desorbed, the analytes cryofocused, and subsequently transferred to a capillary column gas chromatograph.

34496 (PB–89-138861/XAB) **Episodic Response Pproject research plan.** Thornton, K.; Baker, J.P.; Marmorek, D.; Bernard, D.; Eshleman, K.N. FTN Associates, Little Rock, AR (USA). Feb 1988. 255p. Available from NTIS, PC A12/MF A01.

In some geographic locations, acidic deposition is known to be affecting surface water chemistry on both long-term and short-term time scales. Considerable research in the past decade has greatly improved our understanding of the biological effects of acidification, particularly the relationship between chronic chemical conditions and biological responses. In comparison, relatively little is known about the role that short-term acidification is having on the composition or functioning of aquatic biological communities. Despite this scientific uncertainty, it is generally presumed that short-term acidification ('episodes') can result in significant adverse effects on aquatic resources of interest, particularly fish communities. Recognizing episodes as a potentially important source of uncertainty in index-based estimates of acidic deposition effects on populations of lakes and streams, the EPA has initiated the Episodic Response Project (ERP). From an acidification perspective, the ERP is designed primarily to quantify this component of uncertainty in regional population estimates, and to determine the degree to which acidic episodes adversely affect fish populations.

34497 (PB–89-139737/XAB) **Fish as sentinels of environmental health. Technical memo.** Murchelano, R.A. National Marine Fisheries Service, Woods Hole, MA (USA). Northeast Fisheries Center. Sep 1988. 23p. (NOAA-TM-NMFS-F/NEC–61). Available from NTIS, PC A03/MF A01.

Boston Harbor, Massachusetts, is polluted by storm water runoff, municipal wastewater, and sewage sludge, as well as riverborne domestic and industrial pollutants, and introductions characteristic of and related to the sustained heavy commercial ship traffic in the port. Shallow areas of the inner harbor provide suitable spawning and nursery areas for winter flounder (Pseudopleuronectes americanus). The harbor contains large numbers of winter flounder during most of the year and is virtually a sanctuary for the species since commercial fishing is prohibited. Recent disease surveys have shown that harbor winter flounder have a high prevalence of gross and microscopic hepatic lesions, including carcinomas. Although harbor sediments contain high concentrations of polycyclic aromatic hydrocarbons (PAH) and polychlorinated biphenyls (PCB), presently the evidence ascribing either one of these organic chemicals as a direct cause of the neoplastic lesions observed is circumstantial.

34498 (PB–89-140016/XAB) **Cape Cod Aquifer Management Project (CCAMP): hydrogeologic papers. Report for August 1985-December 1987.** Massachusetts Dept. of Environmental Quality Engineering, Boston, MA (USA). Sep 1988. 40p. Available from NTIS, PC A03/MF A01.

See also PB–89-106298 and PB–89-140024.

The project was initiated in 1985 with the goal of studying existing federal, state, and local programs for protecting and preserving Cape Cod's sole-source aquifer. To meet this need, the Massachusetts Department of Environmental Quality Engineering and the U.S. Environmental Protection Agency's Region 1 in cooperation with the Cape Cod Planning and Economic and Development Commission and the U.S. Geological Survey initiated a two-year study to determine the adequacy of current ground-water protection programs and to recommend improvements. In the process of gathering and evaluating hydrogeological data from the Towns of Barnstable and Eastham, the CCAMP Aquifer Assessment Committee developed the papers which are the subject of this publication. These studies formed the technical basis for groundwater resource management decision making.

34499 (PB–89-140024/XAB) **Cape Cod Aquifer Management Project (CCAMP): institutionsl recommendations. Report for August 1985-December 1987.** Massachusetts Dept. of Environmental Quality Engineering, Boston, MA (USA). Sep 1988. 53p. Available from NTIS, PC A04/MF A01.

See also PB–89-140016 and PB–89-106298.

The project was initiated in 1985 with the goal of studying existing federal, state, and local programs for protecting and preserving Cape Cod's sole-source aquifer. To meet this need, the Massachusetts Departmnt of Environmental Quality Engineering, U.S. Environmental Protection Agency's Region 1 in cooperation with the Cape Cod Planning and Economic and Development Commission and the U.S. Geological Survey initiated a two-year study to determine the adequacy of current ground-water protection programs and to recommend improvements. This document focuses on specific recommendations for the improvement of local, state, and federal programs to protect this resource.

34500 (PB–89-143028/XAB) **Wetland Evaluation Technique (WET). Volume 2. Methodology. Operational draft. Final report, June 1984-September 1988.** Adamus, P.R.; Clairain, E.J.; Smith, R.D.; Young, R.E. Army Engineer Waterways Experiment Station, Vicksburg, MS (USA). Oct 1987. 171p. Available from NTIS, PC A08/MF A01.

See also PB–84-241165.

This manual outlines a Wetland Evaluation Technique (WET) for the assessment of wetland functions and values. Wetland functions are the physical, chemical, and biological characteristics of a wetland. Wetland values are those characteristics that are beneficial to society. WET evaluates the following functions and values: groundwater recharge, ground-water discharge, floodflow alteration, sediment stabilization, sediment/toxicant retention, nutrient removal/transformation, production export, wildlife diversity/abundance, aquatic diversity/abundance, uniqueness/heritage, and recreation.

34501 **History of metal pollution in the Southern California Bight: an update.** Finney, B.P. (Oregon State Univ., Corvallis (USA)); Huh, C. *Environmental Science and Technology (USA),* 23(3): 294-303 (Mar 1989).

Box cores collected in 1985 and 1986 along an offshore transect in the Santa Monica Basin, CA, were analyzed for organic carbon, calcium carbonate, U-series radionuclides, and a suite of major and minor elements. Downcore profiles of metals and organic carbon reflect anthropogenic influence and diagenetic processes. The deep basin cores show pronounced subsurface maxima in Pb, Zn, Cr, and organic carbon during the time interval 1960-1970. Increases from the base of the core to this time horizon are consistent with increasing anthropogenic inputs to the Santa Monica Basin. The near-surface decreases in heavy-metal accumulation reflect recent improvements in waste water treatment. Sediment compositions cannot be fully explained by simple mixtures of sewage particles and natural sediment because of factors such as diagenesis of sewage during transport and sedimentation, additional metal sources, and variations in surface water productivity. The yellow-brown surface layer in deep basin cores is relatively enriched in Fe, Co, Cu, and P. This layer forms by reduction of Fe followed by upward diffusion and precipitation as amorphous oxyhydroxides; P, Cu, and Co, released during early diagenesis, are associated with this phase.

34502 **Natural trace metal concentrations in estuarine and coastal marine sediments of the southeastern United States.** Windom, H.L. (Skidaway Institute of Oceanography, Savannah, GA (USA)); Schropp, S.J.; Calder, F.D.; Ryan, J.D.; Smith, R.G. Jr.; Burney, L.C.; Lewis, F.G.; Rawlinson, C.H. *Environmental Science and Technology (USA),* 23(3): 314-320 (Mar 1989). DOE Contract FG09-86ER60435.

Over 450 sediment samples from estuarine and coastal marine areas of the southeastern US remote from contaminant sources

were analyzed for trace metals. Although these sediments are compositionally diverse, As, Co, Cr, Cu, Fe, Pb, Mn, Ni, and Zn concentrations covary significantly with aluminum, suggesting that natural aluminosilicate minerals are the dominant natural metal bearing phases. Cd and Hg do not covary with aluminum apparently due to the importance of the contribution of natural organic phases to their concentration in sediments. It is suggested that the covariance of metals with aluminum provides a useful basis for identification and comparison of anthropogenic inputs to southeastern US coastal/estuarine sediments. By use of this approach sediments from the Savannah River, Biscayne Bay, and Pensacola Bay are compared.

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Refer also to citation(s) 33219, 33220, 33325, 33326, 33548, 34056, 34064, 34448, 34449, 34477, 34501, 34673, 35492

34503 (BMU–1988-205) **Model investigations on the propagation of artificial radionuclides in the North Sea.** Mueller-Navarra, S.H.; Mittelstaedt, E. Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.); Deutsches Hydrographisches Inst. (DHI), Hamburg (Germany, F.R.). 1988. 118p. (In German). Available from GRM Werbeberatung - Werbemittlung - PR, Eggenstein-Leopoldshafen, (Germany, F.R.).

The radioactive discharges from the nuclear fuel reprocessing plants Sellafield Works and La Hague caused in the North Sea water an around 1 to 3 order of magnitude higher activity concentration of Cs then in the North Atlantic. The simulation method used for medium-term 3-dimensional spreading processes over time periods of at least several months was compared with the activity concentration distribution of Cs-137 in the North Sea water measured in the past. Accordingly, the model calculations reproduce correctly the large scale characteristics of the cesium spreading observed. An essential part of the investigation concerned itself with the radioactive contaminations of the North Sea water as the result of fictitious operational accidents at nuclear power stations near the coasts (Hartlepool, Sizewell) and adjacent to rivers (Rhine, Elbe). In addition, marine disasters in different regions of the North Sea, in which a threat of radioactivity comes into play, were simulated.

34504 (DOE-RW–89.024) **Capabilities and requirements for modelling radionuclide transport in the geosphere.** Paige, R.W.; Piper, D. Department of the Environment, London (UK). Feb 1989. 36p. (WSA-TR–22). Order Number DE89617980/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

This report gives an overview of geosphere flow and transport models suitable for use by the Department of the Environment in the performance assessment of radioactive waste disposal sites. An outline methodology for geosphere modelling is proposed, consisting of a number of different types of model. A brief description of each of the component models is given, indicating the purpose of the model, the processes being modelled and the methodologies adopted. Areas requiring development are noted.

34505 (KAPL–4709) **Knolls Atomic Power Laboratory annual environmental monitoring report: Calendar year 1988.** Knolls Atomic Power Lab., Schenectady, NY (USA). 1988. 91p. Sponsored by DOE Nuclear Energy. DOE Contract AC12-76SN00052. Order Number DE89014684/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

The results of the effluent and environmental monitoring programs at the three Knolls Atomic Power Laboratory (KAPL) sites are summarized and assessed in this report. Operations at the three KAPL sites resulted in no significant release of hazardous substances or radioactivity to the environment. The effluent and environmental monitoring programs conducted by KAPL are designed to determine the effectiveness of treatment and control methods, to provide measurement of the concentrations in effluents for comparison with applicable standards, and to assess resultant concentrations in the environment. The monitoring programs include analyses of samples of liquid and gaseous effluents for chemical constituents and radioactivity as well as monitoring of environmental air, water, sediment, and fish. Radiation measurements are also made around the perimeter of each site and at off-site background locations. KAPL environmental controls are subject to applicable state and federal regulations governing use, emission and/or disposal of solid, liquid and gaseous materials. Liquid effluents and air emissions are controlled and monitored in accordance with permits issued by the Connecticut Department of Environmental Protection for the Windsor Site and by the New York State Department of Environmental Conservation for the Knolls and Kesselring Sites. The liquid effluent monitoring data show that KAPL has maintained a high degree of compliance with permit requirements. When required, radionuclide air emission permits are issued by the Environmental Protection Agency (EPA). All air emissions conformed to applicable state and federal standards. 41 refs., 12 figs., 46 tabs.

34506 (OEVS-Mitteilung–1988, pp. 243-247) **Radiation exposition from radionuclides in ground water.** Paretzke, H.G. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Inst. fuer Strahlenschutz); Proehl, G. Oesterreichischer Verband fuer Strahlenschutz (OeVS), Vienna (Austria). Nov 1988. (In German). (CONF-860969–: 4. European congress and 13. regional congress of the International Radiation Protection Association, Salzburg, Austria, 15-19 Sep 1986). In *4. European congress and 13. regional congress of IRPA. 20 years experience in radiation protection - a review and outlook.* Order Number DE89613806/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

A problem for the future is the possible leakage of radionuclides from radioactive wastes end storage. The paths to the population - drinking water, food, etc. - and the calculation scheme of doses for adults and infants respectively are presented. The doses for about 30 radionuclides are given in tables. Generally for adults the rain path is the most important. For infants, milk and drinking water are the most important paths. 8 refs., 1 fig., 2 tabs. (qui).

34507 (OEVS-Mitteilung–1988, pp. 761-764) **Tritium activity in precipitation and in tap water of nw Yugoslavia after the Chernobyl accident.** Krajcar-Bronic, I. (Institut Rudjer Boskovic, Zagreb (Yugoslavia)); Srdoc, D.; Obelic, B.; Hernaus, E. Oesterreichischer Verband fuer Strahlenschutz (OeVS), Vienna (Austria). Nov 1988. (CONF-860969–: 4. European congress and 13. regional congress of the International Radiation Protection Association, Salzburg, Austria, 15-19 Sep 1986). In *4. European congress and 13. regional congress of IRPA. 20 years experience in radiation protection - a review and outlook.* Order Number DE89613806/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

Tritium activity of samples of precipitation collected daily at IAEA/WMO network station Zagreb, Yugoslavia was measured after the accident at the nuclear power plant Chernobyl in USSR. Tritium activity peak in rainwater was observed on May 2. The tritium activity of water supply of Zagreb and in several wells in Plitvice lakes area in nw Yugoslavia showed no increase after the accident. 7 refs., 1 fig., 1 tab.

34508 (SKI–86076(pt.1)) **Geochemical computer codes. A review. Final report.** Andersson, K. Swedish Nuclear Power Inspectorate, Stockholm (Sweden). 11 Aug 1987. 108p. (STUDSVIK-NP–87-86). Order Number DE89617981/JAW. Available from NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS.

In this report a review of available codes is performed and some code intercomparisons are also discussed. The number of codes treating natural waters (groundwater, lake water, sea water) is large. Most geochemical computer codes treat equilibrium conditions, although some codes with kinetic capability are available. A geochemical equilibrium model consists of a computer code, solving a set of equations by some numerical method and a data base, consisting of thermodynamic data required for the calculations. There are some codes which treat coupled geochemical and transport modeling. Some of these codes solve the equilibrium and transport equations simultaneously while other solve the equations separately from each other. The coupled codes require a large computer capacity and have thus as yet limited use. Three code intercomparisons have been found in literature. It may be concluded that there are many codes available for geochemical calculations but most of them require a user that us quite familiar with the code. The user also has to know the geochemical system in order to judge the reliability of the results. A high quality data base is necessary to obtain a reliable result. The best results may be expected

for the major species of natural waters. For more complicated problems, including trace elements, precipitation/dissolution, adsorption, etc., the results seem to be less reliable. (With 44 refs.)

34509 (SKI–86076(pt.2)) **PHREEQE Geochemical equilibrium code data base and calculations. Final report.** Andersoon, K. Swedish Nuclear Power Inspectorate, Stockholm (Sweden). 24 Aug 1987. 39p. (STUDSVIK-NP–87-91). Order Number DE89617982/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Compilation of a thermodynamic data base for actinides and fission products for use with PHREEQE has begun and a preliminary set of actinide data has been tested for the PHREEQE code in a version run on an IBM XT computer. The work until now has shown that the PHREEQE code mostly gives satisfying results for specification of actinides in natural water environment. For U and Np under oxidizing conditions, however, the code has difficulties to converge with pH and Eh conserved when a solubility limit is applied. For further calculations of actinide and fission product specification and solubility in a waste repository and in the surrounding geosphere, more data are needed. It is necessary to evaluate the influence of the large uncertainties of some data. A quality assurance and a check on the consistency of the data base is also needed. Further work with data bases should include: an extension to fission products, an extension to engineering materials, an extension to other ligands than hydroxide and carbonate, inclusion of more mineral phases, inclusion of enthalpy data, a control of primary references in order to decide if values from different compilations are taken from the same primary reference and contacts and discussions with other groups, working with actinide data bases, e.g. at the OECD/NEA and at the IAEA.

34510 (SNV–3497) **Cesium in perch in lakes from northern Sweden after Chernobyl. Present situation, relationships, trends.** Haakanson, L.; Andersson, T.; Nilsson, Aa.; Neumann, G.; Notter, M. Statens Natuurvaardsverk, Solna (Sweden). May 1988. 136p. (In Swedish). Order Number DE89618012/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

The aim of this project is to find measures to reduce the level of radioactive cesium in fish. 41 lakes in east central Sweden that received large amounts of cesium after the Chernobyl accident are studied. Most lakes have perch with cesium content for above the present maximum acceptable limit of 1500 Bq/kg wet weight. The median values for 1986 and 1987 were 3950 and 2650 Bq/kg respectively. The possibilities for speeding up the natural decrease of cesium 137 by liming (to counteract the acidification) and adding nutrient (N and P, to increase bioproduction and 'dilute' the cesium contents) are analyzed. 4-7000 lakes in Sweden are supposed to have fish with cesium levels above 1500 Bq/kg. A preliminary recovery prognosis is given. (12 p. English summary) (L.E.).

34511 **Radionuclide cycling in natural waters.** Santschi, P.H. (EAWAG, CH-8600 Dubendorf (CH)); Nyffeler, U.P.; Li, Y.H.; O'Hara, P. v.v of Sediments and water interactions. Sly, P.G. Springer-Verlag New York Inc., New York, NY (1986). (CONF-8408166–: 3. international symposium on interactions between sediments and water, Geneva, Switzerland, 28-31 Aug 1984).

Apparent sorption rate constants on oceanic particles were measured in batch experiments for a series of soluble and particle-reactive radionuclides. The authors have found that radionuclide uptake by natural particles is slow compared to adsorption rates onto defined oxide surfaces. Equilibrium is attained only at time scales of days. One reason for slow scavenging reactions is the coagulation of radioactively tagged colloidal particles onto larger (filterable) particles. This interpretation explains both the slow sorption (scavenging) kinetics and the dependence of the sorption rate and the distribution ratio (K_d) on the particle concentration. The sorption rate constants for Th isotopes calculated by this method are in good agreement with the rates determined by in situ measurements of the U/Th disequilibrium. In areas where particle residence times are shorter than the time scales of the sorption reactions, such as in shallow coastal marine ecosystems, radioisotope removal from the water column can become limited by the kinetics of sorption onto resuspended particles. If the authors use a simple box model, typical particle residence times, and rate constants for the sorption reactions of Th isotopes that depend on the particle concentration, they can predict residence times of Th isotopes for environments with particle fluxes varying over six orders of magnitude. The fact that these estimates are consistent with those measured directly by the U/Th disequilibrium method implies that Th isotopes might be natural coagulometers; that is, they might be good indicators of coagulation reactions of colloidal-sized particles in natural waters.

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Refer also to citation(s) 33379, 34489

34512 (PB–89-141063/XAB) **Ground-water management under the appropriation doctrine. Technical report.** Ralston, D.; Bruhl, E.J. Idaho Univ., Moscow, ID (USA). Coll. of Mines and Earth Resources. Aug 1988. 187p. Available from NTIS, PC A09/MF A01.

See also PB–87-197349.

The purpose of the research is to better understand the characteristics of ground-water management under the prior-appropriation doctrine in the western United States. The general objective is to summarize the legal and administrative controls on ground-water use in eight western states and to compare the impacts of these controls on ground water systems.

34513 (PB–89-162275/XAB) **Fiscal Year 1987 program report: Texas Water Resources Institute.** Jordan, W.R. Texas A and M Univ., College Station, TX (USA). Water Resources Inst. Oct 1988. 40p. Available from NTIS, PC A03/MF A01.

See also PB–88-132790.

Contents include: water problems and issues of Texas; program goals and priorities; research project synopses: (stochastic simulation of the nonpoint-source runoff process, the role of particles in controlling toxic chemical contamination in surface waters, reuse of municipal and industrial waste water in agriculture - strategies to enhance system selection, and optimizing reservoir operations in Texas); information transfer activities; information management systems synopses.

5206 Regulations

Refer also to citation(s) 34457, 34480, 34482, 34483, 34484

34514 (AD-A–201505/5/XAB) **Air Force ground-water contamination cleanup: an evaluation of the pump-and-treat method. Master's thesis.** Ammons, R.P. Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). Sep 1988. 134p. (AFIT/GEM/DEM–88S-01). Available from NTIS, PC A07/MF A01.

This thesis is an attempt to determine the effectiveness of the Air Force's use of pump-and-treat technology to remediate groundwater contamination. The study is divided into four major sections: (1) literature survey of ground-water contamination problems and remediation technology; (2) identification of bases where pump-and-treat technology has been employed; (3) collection of quantitative data from bases for analysis; (4) analysis of data and recommendations. Data were obtained from three Air Force installations, McClellan AFB, Wright-Patterson AFB, and Wurtsmith AFB. During remediation, contaminants in most cases show a significant decrease in concentration though levels are still well above regulatory agency requirements. Furthermore, it was found that the inconsistent timing of data sampling and the lack of standardized data storage procedures prevents reliable determination of remediation effectiveness. Conclusions of this study are that a standardized data collection system be created, under direct supervision of an air staff office, and that a centralized procedure be identified for evaluating the effectiveness of pump-and-treat programs. While the current remediation programs using pump-and-treat initially show large reductions in contaminant concentrations, continued application of this method produces only slight incremental improvements. It appears that decades may be required to meet existing regulatory limits.

34515 (AD-A–201586/5/XAB) **United States Air Force Installation-Restoration Program (IRP) strategies for investigating migrating contaminated ground-water. Master's thesis.** DeWall, M.L. Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Systems and Logistics. Sep 1988. 128p. (AFIT/GEM/DEM–88S-4). Available from NTIS, PC A07/MF A01.

DOD IRP Remedial Investigations (RI) are often too long and drawn out. The goal of RI is to confirm and quantify soil and ground-water contamination. Often, RI costs exceed estimates and time schedules. Environmental regulators and local residents become distressed over the apparent lack of progress being made. Current RI strategies employed at most Air Force installations involve contamination-plume delineation. This strategy for investigation often does not reveal adequate information regarding movement of contaminants. A thorough understanding of the hydrogeological setting is essential to obtain maximum improvement of ground-water quality. An alternative strategy is Transport Quantification (TQ), a process that identifies and quantifies ground-water flow characteristics prior to, or during, contamination investigation. TQ emphasizes surficial and geological investigations and incorporates ground-water flow models. Preliminary investigations focusing on soil and ground-water characterization can greatly reduce the effort and expense of ground-water investigation and restoration. It was also found that a severe lack of manning within the environmental function exists. Without technical personnel administering the IRP, the program will continue to be run ineffectively. The study revealed a need for a better data transfer and communication between base level offices and higher headquarters, between headquarters, and between services. The AF Engineering and Services Center and USAF OEHL are working on solutions to these problems.

55 BIOMEDICAL SCIENCES, BASIC STUDIES

Refer also to citation(s) 34048

5502 Biochemistry

Refer also to citation(s) 33350, 33351, 33352, 33383, 33384, 33385, 33387, 34520

34516 RNA structure from A to Z. Tinoco, I. Jr. (Univ. of California, Berkeley (USA)); Davis, P.W.; Hardin, C.C.; Puglisi, J.D.; Walker, G.T.; Wyatt, J. pp. 12 of Cold Spring Harbor symposia on quantitative biology. Volume 52, Evolution of catalytic function. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1987). From Cold Spring Harbor symposia on quantitative biology: evolution of catalytic function; Cold Spring Harbor, New York, USA; Jul 1987.

RNA performs a wide variety of known functions in biological systems, and it probably is involved in an even greater variety of as yet unknown functions. It is the genome in RNA viruses, virusoids, and viroids; in viroids, it sometimes catalyzes its own specific cleavage. The design and construction of proteins are controlled by messenger RNAs, ribosomal RNAs, and transfer RNAs. These RNAs are formed from their primary transcripts by a processing that can involve RNA enzymes and small nuclear RNAs. Catalytic RNAs (ribozymes) have been shown to operate on polynucleotides and polysaccharides. Intrinsic RNA components are involved in the signal-recognition particle, which mediates the extrusion of proteins through cell membranes. RNA also plays important roles in control of replication, transcription, and translation. All of these different RNA functions require different RNA structures. Here, they discuss a variety of structural elements that contribute to the secondary and tertiary structures of RNA.

34517 (DOE/ER/13461–3) **Active and passive calcium transport systems in plant cells: Progress report, January 1986–June 1989.** Sze, H. Maryland Univ., College Park, MD (USA). Dept. of Botany. 1989. 5p. Sponsored by DOE Energy Research. DOE Contract FG05-86ER13461. Order Number DE89014714/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The objectives of this proposal are to identify and characterize active (energy-dependent) and passive calcium transport systems that work together to regulate calcium levels in the cytoplasm of plant cells. Several different energy-dependent Ca transport systems have been identified and characterized from oat root tissue (a monocot tissue) and carrot suspension cells (a dicot tissue). They are described in more detail below. I also have included in this progress report our continuing studies to understand the mode of action of the Helminthosporium maydis T toxin. This study was initially supported by a preceding DOE grant. The time needed to complete the study overlapped partly with the present grant period.

34518 (INIS-mf–11980) **Investigations into the binding of ^{125}I-calmodulin to CA^{++} transport ATPase of human erythrocytes.** Sterk, V. Ulm Univ. (Germany, F.R.). Fakultaet fuer Theoretische Medizin. 1983. 81p. (In German). Order Number DE89783068/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

The study described was carried out in order to investigate the binding of ^{125}I-calmodulin to Ca^{++} transport ATPase using different Ca^{++} concentrations and temperatures. The data obtained from these experiments were subsequently analysed in such as a way as to yield meaningful information relating to the mechanisms underlying the attachment of calmodulin to Ca^{++} transport ATPase, the % proportion of membrane protein that was attributable to the enzyme as well as the number of calmodulin receptor sites on the individual erythrocytes, etc. Comparisons with data from the relevant literature permitted conclusions to be drawn concerning the mode of Ca^{++} transport at the level of the erythrocytes. A new methodology and processing technique had to be developed prior to the beginning of the experiments.

34519 Negative regulatory element associated with potentially functional promoter and enhancer elements in the long terminal repeats of endogenous murine leukemia virus-related proviral sequences. Ch'ang, L.Y. (Oak Ridge National Lab., TN (USA)); Yang, W.K.; Myer, F.E.; Yang, D.M. *Journal of Virology (USA),* 63(6): 2746-2757 (Jun 1989). DOE Contract AC05-84OR21400.

Three series of recombinant DNA clones were constructed, with the bacterial chloramphenical acetyltransferase (CAT) gene as a quantitative indicator, to examine the activities of promoter and enhancer sequence elements in the 5' long terminal repeat (LTR) of murine leukemia virus (MuLV)-related proviral sequences isolated from the mouse genome. Transient CAT expression was determined in mouse NIH 3T3, human HT1080, and mink CCL64 cultured cells transfected with the LTR-CAT constructs. The 700-base pair (bp) LTRs of three polytropic MuLV-related proviral clones and the 750-bp LTRs of four modified polytropic proviral clones, in complete structures either with or without the adjacent downstream sequences, all showed very little or negligible activities for CAT expression, while ecotropic MuLV LTRs were highly active. The MuLV-related LTRs were divided into three portions and examined separately. The 3' portion of the MuLV-related LTRs that contains the CCAAC and TATAA boxes was found to be a functional promoter, being about one-half to one-third as active as the corresponding portion of the ecotropic MuLV LTRs. A MboI-Bg/II fragment, representing the distinct 190- to 200-pb inserted segment in the middle, was found to be a potential enhancer, especially when examined in combination with the simian virus 40 promoter in CCL64 cells. A PstI-MboI fragment of the 5' portion, which contains the protein-binding motifs on the enhancer segment as well as the upstream LTF sequences, showed moderate enhancer activities in CCL6 cells but was virtually inactive in NIH 3T3 cells and HT1080 cells; addition of this fragment to the ecotropic LTR-CAT constructs depressed CAT expression.

5503 Cytology

Refer also to citation(s) 34621, 34711

5506 Medicine

Refer also to citation(s) 33980, 34226, 34439, 34678, 34679, 34681, 34682

34520 (IAEA-TECDOC–486, pp. 55-67) **Study of radiation immobilization of bioactive materials.** Wu Jilan (Beijing Univ., BJ (China). Dept. of Technical Physics); Ha Hongfei; Wang Guanghui. International Atomic Energy Agency, Vienna (Austria). Dec 1988. (CONF-8706397–: Final research co-ordination meeting on application of radiation technology in immobilization of bioactive materials, Beijing, China, 15-18 Jun 1987). In *Radiation technology for immobilization of bioactive materials. Proceedings of the final research*

co-ordination meeting held in Beijing, 15-18 June 1987. Order Number DE89617908/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

The research results which were done within two years in authors' Lab. will be reported as follows: (a) Radiation immobilization of horse radish peroxidase(HRP) by means of entrapping. (b) Immobilization of HRP on segmented polyetherurethane(SPEU) via radiation grafting and studies on properties of immobilized HRP. (c) Immobilization of catalase onto radiation-induced polyacrylamide(PAAM) particles by chemical binding and its application. (d) Initial study on immobilization of antibodies. (author). 9 refs, 11 figs, 1 tab.

34521 (IAEA-TECDOC–486, pp. 141-152) **Radiation immobilized monoclonal antibody for radioimmunoassay of circulating schistosome antigen.** Dessaint, J.P. (Institut Pasteur de Lille, 59 - Villeneuve d'Ascq (France)); Neyrinck, J.L.; Lutsch, C.; Capron, A.; Kaetsu, A.I.; Kumakura, M.; Sun, Y.H.; Hoffman, A.S. International Atomic Energy Agency, Vienna (Austria). Dec 1988. (CONF-8706397–: Final research co-ordination meeting on application of radiation technology in immobilization of bioactive materials, Beijing, China, 15-18 Jun 1987). In *Radiation technology for immobilization of bioactive materials. Proceedings of the final research co-ordination meeting held in Beijing, 15-18 June 1987.* Order Number DE89617908/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

The recognition of the diagnostic potential of circulating parasite antigen has prompted research on immunoassays using immunological reagents labelled by radioisotopes or other tags. Solid-phase immunoassays have generally been used. Yet the shelf-life of immobilized immunological reagents is usually short. By using radiation immobilized monoclonal antibody, a radioimmunoassay is described for detection of circulating cathodic (M) antigen. This assay has higher sensitivity and working range than the reference test using monoclonal antibody absorbed to microtitre plates and the immobilized reagent could be kept at room temperature for periods over one month. This should increase the practicability of monoclonal antibody-based immunoassays in endemic areas. (author). 10 refs, 7 figs, 3 tabs.

34522 (IAEA-TECDOC–486, pp. 113-127) **Immobilization of drugs and proteins by radiation polymerization and biomedical uses of this technique.** Kaetsu, I. (Japan Atomic Energy Research Inst., Takasaki (Japan). Takasaki Radiation Chemistry Research Establishment). International Atomic Energy Agency, Vienna (Austria). Dec 1988. (CONF-8706397–: Final research co-ordination meeting on application of radiation technology in immobilization of bioactive materials, Beijing, China, 15-18 Jun 1987). In *Radiation technology for immobilization of bioactive materials. Proceedings of the final research co-ordination meeting held in Beijing, 15-18 June 1987.* Order Number DE89617908/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

The author's group has studied and developed an immobilization technique of physical entrapping by means of radiation polymerization. This technique was generally applicable to various kinds of biofunctional materials such as drugs, proteins and cells for biomedical and biochemical uses. Three main types of immobilized composites have been developed, (1) needle form composite, (2) thin membrane composite, and (3) fine particle composites. The needle form composites were prepared by radiation cast polymerization and used for drug delivery systems to apply to hormone therapy and immuno-therapy by means of implantation and controlled release. The membrane form composites were prepared by radiation polymerization at low temperatures and used for immunodiagnosis materials. Recently another technique of preparation of immobilized membrane was developed by polymerization with low energy electron beam. The fine particles containing biofunctional components were obtained by suspension and emulsion polymerization. Also, a new technique of preparation of fine particles having a narrow size distribution was developed by precipitation polymerization in a specific solvent with gamma rays. These fine particles have been studied for various functional microspheres and drug targetting. (author). 33 refs, 4 figs, 1 tab.

34523 (IAEA-TECDOC–493) **Improvement of cancer therapy by the combination of conventional radiation and chemical or physical means. Final report of co-ordinated research programmes sponsored by the IAEA 1982-1987.** International Atomic Energy Agency, Vienna (Austria). Jan 1989. 170p. Order Number DE89618103/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

The IAEA has since 1982 supported two co-ordinated research programmes (CRP's) aimed at improving conventional radiotherapy by means of its combination with chemical sensitizers, protectors and hyperthermia. This is a final report on the two CRP's and combines the two final reports prepared by the participants of the two final research co-ordination meetings held in Istanbul and Madras. Refs, figs and tabs.

34524 (IAEA-TECDOC–493, pp. 7-17) **Optimization of the use of radiosensitizers and radioprotectors in clinical radiotherapy.** Awwad, H.K. (National Cancer Inst., Cairo (Egypt). Radiotherapy Dept.); El Badawy, S.; Ghoneim, M. and others. International Atomic Energy Agency, Vienna (Austria). Jan 1989. In *Improvement of cancer therapy by the combination of conventional radiation and chemical or physical means. Final report of co-ordinated research programmes sponsored by the IAEA 1982-1987.* Order Number DE89618103/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

In order to optimize the use of chemical hypoxic cell radiosensitizers this should be limited to those tumours where there is evidence of clinically significant hypoxia. Intercapillary distance measurement in cervical cancer and carcinoma in the bilharzial bladder revealed that chronic hypoxia can interfere with the efficiency of radiotherapy. In two randomised clinical trials involving radical radiotherapy of bladder and cervical cancer, misonidazole in a daily dose of 0.5 g/m^2 (corresponding tumour concentration: 15 ug/g) failed to show a therapeutic gain. In order to optimize the use of the drug it was used in association with an accelerated fractionation scheme involving 3 fractions per day and a daily drug dose of 1.0 g/m^2 (corresponding tumour concentration: 20-30 ug/g). The application of this scheme in a controlled trial involving radical treatment of head and neck cancer and postoperative irradiation of bladder cancer did not result in a significant therapeutic gain. A fifth trial involved the application of a concentrated pre-operative irradiation in bladder cancer with the use of a daily drug dose of 1.5 g/m^2 (corresponding tumour concentration: 40-60 ug/g) did not also improve the local control rate. The 5 trials indicated that the tumour concentration levels attained were not adequate to achieve clinically effective sensitization. SR-2508 and Ro-03-8799 are two agents that are nearly as effective as MISO but are much less toxic and hence a larger total dose may be given with higher tumour concentration levels. The two drugs can be combined with no additive toxicity or drug interaction. In case of bladder cancer the high concentration of SR-2508 in urine may allow diffusion back into the tumour. The radioprotector WR-2721 has a potential of clinical application in association with hemibody irradiation (a large drug dose in association with a single radiation dose). (Abstract Truncated)

34525 (IAEA-TECDOC–493, pp. 19-36) **Radiation, pepleomycin and hyperthermia in the therapy of advanced oral carcinomas.** Krishnamurthi, S. (Cancer Inst., Madras (India)); Shanta, V.; Vasanthan, A.; Balakrishnan, I.S.; Reddy, N.M.S.; Gopalan, N.; Sharma, M.; Sastry, D.V.L. International Atomic Energy Agency, Vienna (Austria). Jan 1989. In *Improvement of cancer therapy by the combination of conventional radiation and chemical or physical means. Final report of co-ordinated research programmes sponsored by the IAEA 1982-1987.* Order Number DE89618103/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

Oral squamous cell carcinoma is the commonest male (29%) and the second commonest female (18%) malignancy seen at the Cancer Institute, Madras. 93% of them are T_3 and T_4 at first attendance. They are essentially a loco-regional disease with little predilection for remote metastases (0.75%). Radiation per se yielded a dismally poor survival (19% 5 year NED). Clinical trials combining R.T. with sensitizers (Synkavit, Hbo., Metronidazole) or cytotoxic drugs (Methotrexate, Bleomycin, Pepleomycin, C.D.D.P., 5 FU, VCR) were conducted at the Institute since 1960. The best results were achieved by a combination of R.T. and BLM (C.R. of

70-80%, Recurrence free rate of 60-70% and 5 year NED of 50-60%). These results were consistent and reproducible in repeated trials and in unselected series. There was, however, a persistent failure in about 40% of cases. Adding, Hbo, 5 FU and VCR did not significantly improve results. Cis-platin + BLM + R.T., however, improved results significantly. (author). 11 refs.

34526 (IAEA-TECDOC–493, pp. 37-46) **Radiosensitization of hypoxic bacterial cells and animal tumors by membrane active drugs and hyperthermia.** Singh, B.B. (Bhabha Atomic Research Centre, Bombay (India). Molecular Biology and Agriculture Div.); Srinivasan, V.T.; Shenoy, M.A.; George, K.C.; Maniar, H.S.; Rawat, K.P. International Atomic Energy Agency, Vienna (Austria). Jan 1989. In *Improvement of cancer therapy by the combination of conventional radiation and chemical or physical means. Final report of co-ordinated research programmes sponsored by the IAEA 1982-1987.* Order Number DE89618103/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

Phenothiazine derivatives, well known for their interaction with the cellular membranes has been found to radiosensitize hypoxic cells and radioprotect euoxic cells. They have also been observed to modify the microviscosity of the membrane which is partly responsible for these effects. Such drugs also protected normal mice against whole body exposures and at the same time enhanced the radiation response of animal tumors. The therapeutic effects of hyperthermia and some common anti-cancer drugs like cyclophosphamide (CY) and melphalan (MEL), were enhanced in the presence of phenothiazine derivatives. Among these, trimeprazine appeared to be most effective. Indomethacin, a non-steroidal anti-inflammatory drug which is also membrane active has also been found to exhibit radiosensitizing effect in animal tumors. Cell proliferation kinetics and morphological studies on animal tumors exposed to hyperthermia have yielded interesting results. (author). 18 refs, 2 tabs.

34527 (IAEA-TECDOC–493, pp. 47-58) **Sequencing, timing and doses with the combination of heat and radiation in the treatment of human tumors.** Arcangeli, G. (Istituto Medico e di Ricerca Scientifica, Rome (Italy)). International Atomic Energy Agency, Vienna (Austria). Jan 1989. In *Improvement of cancer therapy by the combination of conventional radiation and chemical or physical means. Final report of co-ordinated research programmes sponsored by the IAEA 1982-1987.* Order Number DE89618103/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

The results from four different phase-II studies on more than 200 multiple superficial lesions treated confirms the experimental observations that hyperthermia enhances the radiation effects in both tumors and normal tissues. The best way to avoid the thermotolerance in tumors and the sensitization of the surrounding normal tissues is to apply hyperthermia once a week to a conventional radiation schedule. Only in particular clinical situations, such as melanoma, which has been found to respond well to radiotherapy given in large doses per fractions, can an attempt to exploit the radiosensitizing effect of heat be made by applying hyperthermia in combination with all radiation fractions every four or five days if the lesions can be preferentially heated with respect to the surrounding normal tissue. These treatment schedules are the basis of treatment protocols employed in multicentre phase-III clinical trials on advanced breast cancer, neck node metastases, and cutaneous and nodal metastases from malignant melanoma, currently underway within the framework of the European Society for Hyperthermic Oncology (ESHO). A careful quality assurance and a detailed guidance of how to measure temperature are "musts" for all studies. (author). 26 refs, 1 fig., 3 tabs.

34528 (IAEA-TECDOC–493, pp. 59-74) **Studies of the combined use of hypoxic cell sensitizers and hyperthermia with radiation in human cancer therapy.** Onoyama, Y. (Osaka City Univ. Medical School (Japan). Dept. of Radiology). International Atomic Energy Agency, Vienna (Austria). Jan 1989. In *Improvement of cancer therapy by the combination of conventional radiation and chemical or physical means. Final report of co-ordinated research programmes sponsored by the IAEA 1982-1987.* Order Number DE89618103/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

Development of the combined use of hypoxic cell radiosensitizer and hyperthermia with radiation in cancer therapy in Japan was reviewed with special reference to the study at the Osaka City University Hospital. (author). 6 figs, 9 tabs.

34529 (IAEA-TECDOC–493, pp. 75-82) **Experimental and clinical studies on hyperthermia and chemical sensitizers in radio- and chemotherapy of cancer.** Sugahara, T. (Kyoto National Hospital Health Research Foundation (Japan)). International Atomic Energy Agency, Vienna (Austria). Jan 1989. In *Improvement of cancer therapy by the combination of conventional radiation and chemical or physical means. Final report of co-ordinated research programmes sponsored by the IAEA 1982-1987.* Order Number DE89618103/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

The research field in the title of the present paper has been called in brief 'Radiosensitization" as has been the title of our Newsletter. Through studies for five years hyperthermia has been established an an effective radio- and chemosensitizing agent though heating techniques and thermometry still remain to be refined. During these five years, two different kinds of activities have been performed, i.e., (i) research works on individual agents such as PLDR inhibitors, radioprotector WR-2721, hyperthermia equipment and analysis of cell killing, and (ii) research promotion by publishing "Radiosensitization Newsletter" quarterly and organizing bilateral workshops such as China-Japan and USSR-Japan. (author). 14 refs, 1 fig., 1 tab.

34530 (IAEA-TECDOC–493, pp. 83-89) **Effect of hypoxic cell sensitizer in radiation therapy of nasopharyngeal carcinoma.** Hidayatalla, A. (Khartoum Univ. (Sudan). Radiation Oncology Unit); Rahman, E.; Hamad, M.M.A.; Sulieman, A.; Mohamed, K. International Atomic Energy Agency, Vienna (Austria). Jan 1989. In *Improvement of cancer therapy by the combination of conventional radiation and chemical or physical means. Final report of co-ordinated research programmes sponsored by the IAEA 1982-1987.* Order Number DE89618103/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

At the Radiation and Isotopes Centre, Khartoum, (RICK) 171 cases of Nasopharyngeal Carcinoma (NPC) were randomised for radiation therapy with or without the radiosensitizer Metronidazole (MET) into four treatment cases as follows: A. Patients: 36; Radiation: 50Gy/L8F/6w; MET: 5-8g dose X6-9/6w; B. Patients: 41; Radiation: 55Gy/30F/6w; MET: 5-8 dose X6-9/6w; C. Patients: 44; Radiation: 50Gy/18F/6w; MET: Not given; D. Patients: 44; Radiation: 55Gy/30F/6w; MET: Not given. Moderately severe but acceptable gastro-intestinal and oropharyngeal mucosal reactions were prominent in cases A and B receiving MET as radiosensitizer than in cases C and D not receiving MET. On the other hand a therapeutic gain has been observed both in the two year survival and in the disease free survival in the treatment given MET in associations with 3F/W regimen with 277 cGy/F, whereas no benefit could be shown in the cases receiving 5F/W regimen with 183 cGy/F. 6 refs, 2 figs, 6 tabs.

34531 (IAEA-TECDOC–493, pp. 91-104) **Treatment of carcinoma of head and neck with a combination of conventional irradiation and methotrexate as radiosensitizer.** Puribhat, S. (National Cancer Inst., Bangkok (Thailand)); Chotigavanich, C.; Tangkaratt, S.; Bhumiswasdi, V.; Phanthumachinda, P. International Atomic Energy Agency, Vienna (Austria). Jan 1989. In *Improvement of cancer therapy by the combination of conventional radiation and chemical or physical means. Final report of co-ordinated research programmes sponsored by the IAEA 1982-1987.* Order Number DE89618103/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

Between 6 February 1984 to 11 September 1986, 200 cases of cancer of head and neck were randomised into control group (105), i.e. conventional irradiation treatment and trial group (95), i.e. MTX 50 mg. i.v. on day 1 and followed by conventional irradiation. Early complications were tolerable as well as late complications. Good response rate in trial group was significant. One case in trial group developed a second primary. Long term benefit is to be documented. (author). 16 refs, 7 tabs.

34532 (IAEA-TECDOC–493, pp. 105-122) **Use of ornidazole as a radiosensitizer on fractionated irradiation: Results of clinical trials.** Okkan, S. (Istanbul Univ. (Turkey). Cerrahpasa Faculty of Medicine, Dept. of Radiotherapy); Uzel, R.; Turkan, S.; Yazici, Z.; Akcasu, A.; Turan, N.; Hacibekiroglu, M. International Atomic Energy Agency, Vienna (Austria). Jan 1989. In *Improvement of cancer therapy by the combination of conventional radiation and chemical or physical means. Final report of co-ordinated research programmes sponsored by the IAEA 1982-1987.* Order Number DE89618103/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

In order to investigate the sensitizing effect of ornidazole, a double-blind randomized trial was devised, in patients with carcinoma of the cervix and larynx. Sixty-eight patients with carcinoma of the cervix and 42 patients with carcinoma of the larynx were randomized and followed-up from 6 to 56 months. All patients with cervical carcinoma first received external irradiation, followed by intracavitary application. Fifty-four patients received 7.5 Gy in two fractions in 1st and 3rd week. Conventional daily fractionation of 2 Gy was given in 2nd, 4th and 5th week. In the remaining 14 cases weekly dose of 7.5 Gy was given in 1st, 3rd and 5th week and conventional daily fractionation in 2nd and 4th week. Intracavitary brachytherapy followed, by giving 2 fractions of 10.83 Gy each, one week apart. The patients received ornidazole or placebo 3 h before the irradiation in a dose of 2.5 g/m^2 in 1st and 3rd (also in 5th for 14 patients) week and intracavitary treatment. In patients with laryngeal tumours conventional fractionation was used and 70 Gy was given in 7 weeks. Ornidazole or placebo were given two times weekly in 3rd, 4th and 5th week in a dose of 2.5 g/m^2. The results showed that there was no difference in local control and the survival rates in the ornidazole or placebo groups with carcinoma of the larynx. In patients with carcinoma of the cervix the local control rate seems somewhat better in the ornidazole group (71% versus 53%). Three-year survival rates amounted to 66 and 51% in the ornidazole and placebo groups, respectively. However, these differences are not statistically significant. Although, the local control rate of 62% for the ornidazole compared with 23% for the placebo in stage III_B cases seems statistically significant ($p<0.05$), its evaluation is obscure because of the small numbers. 19 refs, 13 figs, 11 tabs.

34533 (IAEA-TECDOC–493, pp. 123-135) **Combined modality approach: Radiotherapy plus hyperthermia in advanced and early human tumours.** Vazquez, T. (Universidad de la Republica, Montevideo (Uruguay). Facultad de Medicina); Kasdorf, P. International Atomic Energy Agency, Vienna (Austria). Jan 1989. In *Improvement of cancer therapy by the combination of conventional radiation and chemical or physical means. Final report of co-ordinated research programmes sponsored by the IAEA 1982-1987.* Order Number DE89618103/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

Between March 1983 and April 1985, 214 patients with advanced head and neck cancers, recurrent breast tumours in the chest wall, malignant melanomas and secondary adenopathies from unidentified primary tumours, soft tissue sarcomas and non-Hodgkin's lymphomas were submitted to a combined treatment with conventional radiotherapy and hyperthermia (250 KeV, 4 Gy per fraction, 2 fractions per week). A total dose of 40 Gy was given in five weeks plus hyperthermia produced by external microwaves (2450 MHz), in 10 sessions of 1h. each following radiotherapy. Complete regression (CR), partial regression (PR), and non-responders (NR) were distributed according to the kind of tumour treated, as follows: head and neck cancers 78/127 (61.5%) CR, 37/127 (29.1%) PR, 12/127 (9.4%) NR; recurrent breast cancers 23/35 (65.7%) CR, 10/35 (28.6%) PR, 2/35 (5.7%) NR; soft tissue sarcomas 5/7 CR, 2/7 PR; non-Hodgkin's lymphomas 8/8 CR. Our results are similar to those reported by other investigators and confirm the need for continuing research in this field. Another group of 17 patients with early stage ENT tumours (7 mobile tongues, 6 supraglottis, 3 tonsils and 1 piriform sinus) was treated between December 1985 and June 1987. They received 60 Gy Co^{60} external radiotherapy conventionally fractionated plus 10 sessions of external 2450 Mhz microwave hyperthermia given twice a week. The results were compared to an historical control group treated with exclusive irradiation. Actuarial survival for 16 months was 87% for the radiotherapy plus hyperthermia group and 65% for the radiotherapy only group (non-significant). No differences were found in the complications rate and local control. Although follow-up is short, data suggest the validity of the association which allows to reduce the radiation dose. Association modality, radiotherapy plus hyperthermia in human cancers. (author). 27 refs, 1 fig., 11 tabs.

34534 (IAEA-TECDOC–493, pp. 137-145) **Implication of blood flow in sequencing hyperthermia and radiotherapy.** Song, C.W. (Minnesota Univ., Minneapolis (USA). Medical School); Rhee, J.G.; Patten, M.S.; Chelstrom, L.M. International Atomic Energy Agency, Vienna (Austria). Jan 1989. In *Improvement of cancer therapy by the combination of conventional radiation and chemical or physical means. Final report of co-ordinated research programmes sponsored by the IAEA 1982-1987.* Order Number DE89618103/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

The factors which determine the effectiveness of the combined use of heat and radiation in the treatment of malignant tumors are studied. The combined effect markedly varied depending on the order and time interval between the two modalities. An application of heat prior to irradiation caused greater skin damage as compared with that after irradiation. Probably the oxygenation of skin was improved due to an increase in blood flow by heat applied before irradiation. By contrast, an application of heat prior to irradiation was less effective than that after irradiation for tumor control. It appeared that tumors become hypoxic as a result of vascular damage by the heat applied prior to irradiation. It was concluded that heat should be applied after irradiation for maximum control with minimal normal tissue damage. (author). 14 refs, 3 figs, 1 tab.

34535 (IAEA-TECDOC–493, pp. 147-161) **Clinical and experimental study of improvement of radiation therapy using hyperthermia and electron affinic compounds.** Cyb, A. (Akademiya Meditsinskikh Nauk SSSR, Obninsk (USSR). Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii); Konoplyannikov, A. International Atomic Energy Agency, Vienna (Austria). Jan 1989. In *Improvement of cancer therapy by the combination of conventional radiation and chemical or physical means. Final report of co-ordinated research programmes sponsored by the IAEA 1982-1987.* Order Number DE89618103/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

The results of clinical and experimental study conducted at the Research Institute of Medical Radiology of the Academy of Medical Science of the USSR are presented. The investigation of radiosensitizing and cytotoxic effect of microwave hyperthermia allowed to rationalize thermoradiation therapy for cancer. The results of clinical trials with metronidazole as radiosensitizer showed the efficacy of radiation therapy of some types of tumours. The early results of thermoradiotherapy of patients with radioresistant tumours were analysed. The data obtained showed substantial perspectivity of the method. (author). 6 figs, 4 tabs.

34536 (INIS-BR–1516, pp. 44) **Surgery of cancrum of colon.** Veloso, V. and others. Sociedade Brasileira de Cancerologia, Salvador, BA (Brazil). 1988. (In Portuguese). (CONF-8810366–: 2. Iberian-American congress of oncology, Salvador, Brazil, 9-14 Oct 1988). In *Proceedings of the 2. Iberian-American Congress of Oncology.* Order Number DE89613927/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

CARCINOMAS/large intestine; BIOMEDICAL RADIOGRAPHY; CARCINOMAS; DIAGNOSIS; SURGERY

34537 (INIS-BR–1516, pp. 57) **Diagnosis and surgical treatment of phylode tumours.** Silva, M.A. da; Pereira, M.; Pereira, H.; Cruz, D. Sociedade Brasileira de Cancerologia, Salvador, BA (Brazil). 1988. (In Portuguese). (CONF-8810366–: 2. Iberian-American congress of oncology, Salvador, Brazil, 9-14 Oct 1988). In *Proceedings of the 2. Iberian-American Congress of Oncology.* Order Number DE89613927/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

NEOPLASMS/diagnosis; NEOPLASMS/mammary glands; BIOMEDICAL RADIOGRAPHY; IMAGES; NEOPLASMS; DIAGNOSIS; SURGERY; ULTRASONIC WAVES

34538 (INIS-BR–1516, pp. 62) **Radiology of inflammatory carcinoma of breast.** Sabate, J. (Centro Oncologico, Sevilla (Spain). Servicio Radiologia); Virizuela, J.A.; Jimenez, A.; Lozano, A. Sociedade Brasileira de Cancerologia, Salvador, BA (Brazil). 1988. (In Spanish). (CONF-8810366–: 2. Iberian-American congress of oncology, Salvador, Brazil, 9-14 Oct 1988). In *Proceedings of the 2. Iberian-American Congress of Oncology*. Order Number DE89613927/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

CARCINOMAS/diagnosis; CARCINOMAS/mammary glands; BIOMEDICAL RADIOGRAPHY; CARCINOMAS; DIAGNOSIS; INFLAMMATION; RADIOLOGY

34539 (INIS-BR–1516, pp. 65) **Radiology of mucoid carcinoma of breast.** Sabate, J. (Centro Oncologico, Sevilla (Spain). Servico Radiologia); Virizuela, J.A.; Jimenez, A.; Lozano, A. Sociedade Brasileira de Cancerologia, Salvador, BA (Brazil). 1988. (In Spanish). (CONF-8810366–: 2. Iberian-American congress of oncology, Salvador, Brazil, 9-14 Oct 1988). In *Proceedings of the 2. Iberian-American Congress of Oncology*. Order Number DE89613927/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

CARCINOMAS/diagnosis; CARCINOMAS/mammary glands; BIOMEDICAL RADIOGRAPHY; CARCINOMAS; DIAGNOSIS; RADIOLOGY

34540 (INIS-BR–1516, pp. 66) **Radiology of comedocarcinoma of breast.** Sabate, J. (Centro Oncologico, Sevilla (Spain). Servico Radiologia); Virizuela, J.A.; Jimenez, A.; Lozano, A. Sociedade Brasileira de Cancerologia, Salvador, BA (Brazil). 1988. (In Spanish). (CONF-8810366–: 2. Iberian-American congress of oncology, Salvador, Brazil, 9-14 Oct 1988). In *Proceedings of the 2. Iberian-American Congress of Oncology*. Order Number DE89613927/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

CARCINOMAS/diagnosis; CARCINOMAS/mammary glands; BIOMEDICAL RADIOGRAPHY; CARCINOMAS; DIAGNOSIS; RADIOLOGY

34541 (INIS-BR–1516, pp. 92) **Diagnosis and therapeutic of 104 cases of thyroid carcinoma.** Silva, M.A. da; Campos, B.; Ganho, J.; Pereira, H. Sociedade Brasileira de Cancerologia, Salvador, BA (Brazil). 1988. (In Portuguese). (CONF-8810366–: 2. Iberian-American congress of oncology, Salvador, Brazil, 9-14 Oct 1988). In *Proceedings of the 2. Iberian-American Congress of Oncology*. Order Number DE89613927/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

CARCINOMAS/thyroid; CARCINOMAS; THYROID; COBALT 60; DIAGNOSIS; IODINE 131; SURGERY; THERAPY

34542 (INIS-BR–1516, pp. 19) **Value of initial carcinoembryonic antigen in rectal cervix cancer.** Mello, E.L.R.; Rocha, F.; Simoes, J.H.; Corbo, R.; Souza Filho, O.; Fiod, N.J. Sociedade Brasileira de Cancerologia, Salvador, BA (Brazil). 1988. (In Portuguese). (CONF-8810366–: 2. Iberian-American congress of oncology, Salvador, Brazil, 9-14 Oct 1988). In *Proceedings of the 2. Iberian-American Congress of Oncology*. Order Number DE89613927/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

CARCINOEMBRYONIC ANTIGEN/carcinomas; CARCINOEMBRYONIC ANTIGEN/rectum; CARCINOMAS; RECTUM; DIGESTIVE SYSTEM DISEASES; RADIOIMMUNOASSAY

34543 (INIS-BR–1516, pp. 38) **Study of image and biodistribution with a monoclonal antibody in tumors of rats with high and low metastatic capacity.** Koss, A.; Colombo, L.; Glait, H.; Slipak, E.; Horenstein, A. Sociedade Brasileira de Cancerologia, Salvador, BA (Brazil). 1988. (In Spanish). (CONF-8810366–: 2. Iberian-American congress of oncology, Salvador, Brazil, 9-14 Oct 1988). In *Proceedings of the 2. Iberian-American Congress of Oncology*. Order Number DE89613927/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

MONOCLONAL ANTIBODIES/carcinomas; MONOCLONAL ANTIBODIES/radioimmunoassay; IMAGES; IODINE 125; METASTASES; CARCINOMAS; RADIOIMMUNOASSAY; RATS

34544 (INIS-BR–1516, pp. 2) **Contralateral breast carcinoma.** Perez, M.G.; Carrion G, J.R.; Alonso M, A.; Palomero P, I.; Texeira F, R.; Garcia A, P.; Arranz A, J.A. Sociedade Brasileira de Cancerologia, Salvador, BA (Brazil). 1988. (In Spanish). (CONF-8810366–: 2. Iberian-American congress of oncology, Salvador, Brazil, 9-14 Oct 1988). In *Proceedings of the 2. Iberian-American Congress of Oncology*. Order Number DE89613927/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

CARCINOMAS/mammary glands; CARCINOMAS; COMPARATIVE EVALUATIONS; RADIOTHERAPY; SURGERY

34545 (INIS-BR–1516, pp. 5) **Morphometric studies of areas of tumorous necrosis produced by radiotherapy, hyperthermia and its therapeutical combination.** Patricio, M.B.; Soares, J. Sociedade Brasileira de Cancerologia, Salvador, BA (Brazil). 1988. (In Portuguese). (CONF-8810366–: 2. Iberian-American congress of oncology, Salvador, Brazil, 9-14 Oct 1988). In *Proceedings of the 2. Iberian-American Congress of Oncology*. Order Number DE89613927/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

NECROSIS/hyperthermia; NECROSIS/radiotherapy; BIOLOGICAL RADIATION EFFECTS; NECROSIS; HYPERTHERMIA; RADIOTHERAPY; NEOPLASMS; RATS

34546 (INIS-BR–1516, pp. 8) **Treatment and results of 13 cases of ependymoma.** Perez T, A.; Bartolome, A.; Pena, C.; Murillo, M.T.; Perez, E.; Fernandez L, P.; Lanzos, E. Sociedade Brasileira de Cancerologia, Salvador, BA (Brazil). 1988. (In Spanish). (CONF-8810366–: 2. Iberian-American congress of oncology, Salvador, Brazil, 9-14 Oct 1988). In *Proceedings of the 2. Iberian-American Congress of Oncology*. Order Number DE89613927/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

RADIOTHERAPY/neoplasms; BRAIN; RADIOTHERAPY; NEOPLASMS; SURVIVAL TIME

34547 (INIS-BR–1516, pp. 9) **Analysis of prognostic factors in extraganglionary lymphomas, stage IE and IIE.** Gonzalez B, M. (Hospital La Paz, Madrid (Spain). Servicio de Oncologia Medica); Garcia G, C.; Juarez, S.; Ordonez, A.; Vicente, J.; Felin, J.; Martin, G.; Artal, A.; Cebrieros, I. Sociedade Brasileira de Cancerologia, Salvador, BA (Brazil). 1988. (In Spanish). (CONF-8810366–: 2. Iberian-American congress of oncology, Salvador, Brazil, 9-14 Oct 1988). In *Proceedings of the 2. Iberian-American Congress of Oncology*. Order Number DE89613927/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

LYMPHOMAS/radiotherapy; CHEMOTHERAPY; GANGLIONS; LYMPHOMAS; RADIOTHERAPY; SURGERY

34548 (INIS-BR–1516, pp. 11) **CHOP and radiotherapy combined.** Dominguez F, S.; Carrion G, J.R.; Garcia A, P.; Perez F, R.; Flores S, E.; Jara S, C.; Perez M, G. Sociedade Brasileira de Cancerologia, Salvador, BA (Brazil). 1988. (In Spanish). (CONF-8810366–: 2. Iberian-American congress of oncology, Salvador, Brazil, 9-14 Oct 1988). In *Proceedings of the 2. Iberian-American Congress of Oncology*. Order Number DE89613927/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

CHEMOTHERAPY/radiotherapy; CHEMOTHERAPY; RADIOTHERAPY; LYMPHOMAS

34549 (INIS-BR–1516, pp. 14) **Radiosurgical treatment of uterine cervix carcinoma - stage I.** Santos, M.P.; Tavares, M.A.; Belo, M.C.; Vilhena, M. Sociedade Brasileira de Cancerologia, Salvador, BA (Brazil). 1988. (In Portuguese). (CONF-8810366–: 2. Iberian-American congress of oncology, Salvador, Brazil, 9-14 Oct 1988). In *Proceedings of the 2. Iberian-American Congress of Oncology*. Order Number DE89613927/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

CARCINOMAS/urogenital system diseases; CARCINOMAS; RADIOTHERAPY; SURGERY; SURVIVAL TIME

34550 (INIS-BR–1516, pp. 15) **Abdominal irradiation in epithelial carcinoma of ovarium.** Lanzos, E.; Escutia, P.; Bartolome, A.; Sacristan, A.; Pena, C.; Murillo, M.T.; Miranda, P.; Perez T, A. Sociedade Brasileira de Cancerologia, Salvador, BA (Brazil). 1988. (In Spanish). (CONF-8810366–: 2. Iberian-American congress of oncology, Salvador, Brazil, 9-14 Oct 1988). In *Proceedings of the 2. Iberian-American Congress of Oncology*. Order Number

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UROGENITAL SYSTEM DISEASES/carcinomas; UROGENITAL SYSTEM DISEASES/radiotherapy; ABDOMEN; OVARIES; CARCINOMAS; RADIOTHERAPY

34551 (INIS-BR–1516, pp. 17) **Multidisciplinary treatment of gastric cancer.** Guarischi, A.; Azevedo, F.G.; Machado, O.; Polonia, M. Sociedade Brasileira de Cancerologia, Salvador, BA (Brazil). 1988. (In Portuguese). (CONF-8810366–: 2. Iberian-American congress of oncology, Salvador, Brazil, 9-14 Oct 1988). In *Proceedings of the 2. Iberian-American Congress of Oncology*. Order Number DE89613927/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

RADIOTHERAPY/neoplasms; RADIOTHERAPY/stomach; CHEMOTHERAPY; DIGESTIVE SYSTEM DISEASES; GASTRECTOMY; RADIOTHERAPY; NEOPLASMS; STOMACH

34552 (INIS-BR–1516, pp. 18) **Exclusive radiotherapic treatment of adenocarcinoma of rectum.** Sociedade Brasileira de Cancerologia, Salvador, BA (Brazil). 1988. (In Portuguese). (CONF-8810366–: 2. Iberian-American congress of oncology, Salvador, Brazil, 9-14 Oct 1988). In *Proceedings of the 2. Iberian-American Congress of Oncology*. Order Number DE89613927/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

RADIOTHERAPY/carcinomas; RADIOTHERAPY/rectum; DIGESTIVE SYSTEM DISEASES; METASTASES; RADIOTHERAPY; CARCINOMAS; RECTUM

34553 (INIS-BR–1516, pp. 40) **Multidisciplinary treatment in cancer of head and neck.** Cruz, J.J.; Fonseca, E.; Munoz, A.; Gomez, A.; Sanchez, P.; Marin, J.C.; Munhoz, V.M.; Colle, Y. Sociedade Brasileira de Cancerologia, Salvador, BA (Brazil). 1988. (In Spanish). (CONF-8810366–: 2. Iberian-American congress of oncology, Salvador, Brazil, 9-14 Oct 1988). In *Proceedings of the 2. Iberian-American Congress of Oncology*. Order Number DE89613927/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

NEOPLASMS/head; NEOPLASMS/neck; CHEMOTHERAPY; NEOPLASMS; HEAD; NECK; RADIOTHERAPY; SURGERY

34554 (INIS-BR–1516, pp. 42) **Tracheostomy with cutaneous cancer.** Aquino, J.L.B. de; Aquino Netto, P.A. de; Antoniazzi, A.C. Sociedade Brasileira de Cancerologia, Salvador, BA (Brazil). 1988. (In Portuguese). (CONF-8810366–: 2. Iberian-American congress of oncology, Salvador, Brazil, 9-14 Oct 1988). In *Proceedings of the 2. Iberian-American Congress of Oncology*. Order Number DE89613927/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

RADIOTHERAPY/neoplasms; RADIOTHERAPY; NEOPLASMS; SKIN DISEASES; SURGERY; TRACHEA

34555 (INIS-BR–1516, pp. 32) **Alternated chemotherapy in lung microcytic carcinoma. Preliminary results with Iphosphamide, doxorubicin, vincristine (IDV), alternated with carboplatine, cyclophosphamide, VP 16 (C-CF-VP).** Gonzalez B, M.; Vicente, J.; Martin, G.; Felin, J.; Garcia G, C.; Cebreiros, I.; Artal, A.; Ordonez, A. Sociedade Brasileira de Cancerologia, Salvador, BA (Brazil). 1988. (In Spanish). (CONF-8810366–: 2. Iberian-American congress of oncology, Salvador, Brazil, 9-14 Oct 1988). In *Proceedings of the 2. Iberian-American Congress of Oncology*. Order Number DE89613927/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

CARCINOMAS/lungs; ALKYLATING AGENTS; ANTINEOPLASTIC DRUGS; CARCINOMAS; LUNGS; CHEMOTHERAPY; RADIOTHERAPY

34556 (INIS-BR–1516, pp. 47) **Association of surgery and radiotherapy in the treatment of medulloblastoma. Results.** Perez T, A.; Zapatero, A; Dominguez, P.; Ramos, A.; Romasanta, P.; Manas, A.; Lanzos, E. Sociedade Brasileira de Cancerologia, Salvador, BA (Brazil). 1988. (In Spanish). (CONF-8810366–: 2. Iberian-American congress of oncology, Salvador, Brazil, 9-14 Oct 1988). In *Proceedings of the 2. Iberian-American Congress of Oncology*. Order Number DE89613927/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

NEOPLASMS/radiotherapy; NEOPLASMS/surgery; NEOPLASMS; RADIOTHERAPY; SURGERY; SPINAL CORD; VERTEBRAE

34557 (INIS-BR–1516, pp. 47) **Radiotherapeutic treatment of cervix carcinoma, stage III. Results.** Lanzos, E.; Bartolome, A.; Dominguez, P.; Miranda, P.; Perez T, A. Sociedade Brasileira de Cancerologia, Salvador, BA (Brazil). 1988. (In Spanish). (CONF-8810366–: 2. Iberian-American congress of oncology, Salvador, Brazil, 9-14 Oct 1988). In *Proceedings of the 2. Iberian-American Congress of Oncology*. Order Number DE89613927/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

CARCINOMAS/radiotherapy; CARCINOMAS/urogenital system diseases; BIOLOGICAL RADIATION EFFECTS; CARCINOMAS; RADIOTHERAPY; IRRADIATION

34558 (INIS-BR–1516, pp. 48) **Morphometric studies of areas of tumorous necrosis produced by radiotherapy, hyperthermia and its therapeutic combination.** Patricio, M.B.; Soares, J. Sociedade Brasileira de Cancerologia, Salvador, BA (Brazil). 1988. (In Portuguese). (CONF-8810366–: 2. Iberian-American congress of oncology, Salvador, Brazil, 9-14 Oct 1988). In *Proceedings of the 2. Iberian-American Congress of Oncology*. Order Number DE89613927/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

HYPERTHERMIA/necrosis; NEOPLASMS/hyperthermia; NEOPLASMS/radiotherapy; RADIOTHERAPY/necrosis; BIOLOGICAL RADIATION EFFECTS; HYPERTHERMIA; NECROSIS; MICE; NEOPLASMS; RADIOTHERAPY

34559 (INIS-BR–1516, pp. 53) **Fundamental and strategy for the scientific treatment of cancer.** Marinello, Z. Sociedade Brasileira de Cancerologia, Salvador, BA (Brazil). 1988. (In Spanish). (CONF-8810366–: 2. Iberian-American congress of oncology, Salvador, Brazil, 9-14 Oct 1988). In *Proceedings of the 2. Iberian-American Congress of Oncology*. Order Number DE89613927/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

CHEMOTHERAPY/neoplasms; RADIOTHERAPY/neoplasms; SURGERY/neoplasms; BIOLOGICAL EFFECTS; BIOLOGY; CHEMOTHERAPY; NEOPLASMS; COMPARATIVE EVALUATIONS; RADIOTHERAPY; SURGERY

34560 (INIS-BR–1516, pp. 54) **Conservative treatment of breast neoplasm.** Motta, N.W. da; Lima Vargas, E. de; Barletta, A.; Sandri, A.; Schiemann, F.P.G.; Vauthier, G. Sociedade Brasileira de Cancerologia, Salvador, BA (Brazil). 1988. (In Portuguese). (CONF-8810366–: 2. Iberian-American congress of oncology, Salvador, Brazil, 9-14 Oct 1988). In *Proceedings of the 2. Iberian-American Congress of Oncology*. Order Number DE89613927/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

RADIOTHERAPY/carcinomas; MAMMARY GLANDS; RADIOTHERAPY; CARCINOMAS; SURGERY

34561 (INIS-BR–1516, pp. 55) **Breast cancer locally advanced (T3/T4): treatment.** Galvez, C.A.; Bonamassa, M.; Garbovesky, C.; Galmarini, F.; Temperley, G.; Mendez, J. Sociedade Brasileira de Cancerologia, Salvador, BA (Brazil). 1988. (In Spanish). (CONF-8810366–: 2. Iberian-American congress of oncology, Salvador, Brazil, 9-14 Oct 1988). In *Proceedings of the 2. Iberian-American Congress of Oncology*. Order Number DE89613927/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

CARCINOMAS/mammary glands; RADIOTHERAPY/carcinomas; CARCINOMAS; CHEMOTHERAPY; RADIOTHERAPY; SURGERY

34562 (INIS-BR–1516, pp. 56) **Conservative treatment of breast cancrum.** Pereira, M.; Lassalete, P.; Silva, A. da; Alves, R.; Leal, C. Sociedade Brasileira de Cancerologia, Salvador, BA (Brazil). 1988. (In Portuguese). (CONF-8810366–: 2. Iberian-American congress of oncology, Salvador, Brazil, 9-14 Oct 1988). In *Proceedings of the 2. Iberian-American Congress of Oncology*. Order Number DE89613927/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

RADIOTHERAPY/carcinomas; MAMMARY GLANDS; RADIOTHERAPY; CARCINOMAS; SURGERY

34563 (INIS-BR–1516, pp. 58) **Hidden cancer of breast, our experience.** Areco, A.S.; Mantoni, O.A.; Mantoni, G. Sociedade

Brasileira de Cancerologia, Salvador, BA (Brazil). 1988. (In Spanish). (CONF-8810366–: 2. Iberian-American congress of oncology, Salvador, Brazil, 9-14 Oct 1988). In *Proceedings of the 2. Iberian-American Congress of Oncology*. Order Number DE89613927/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

CARCINOMAS/mammary glands; CARCINOMAS/radiotherapy; CARCINOMAS; RADIOTHERAPY; CHEMOTHERAPY; SURGERY

34564 (INIS-BR–1516, pp. 59) **Thymus hormones in cancer. Experience hormones in cancer.** Mario, F.B. Sociedade Brasileira de Cancerologia, Salvador, BA (Brazil). 1988. (In Spanish). (CONF-8810366–: 2. Iberian-American congress of oncology, Salvador, Brazil, 9-14 Oct 1988). In *Proceedings of the 2. Iberian-American Congress of Oncology*. Order Number DE89613927/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

HORMONES/neoplasms; HORMONES/thymus; NEOPLASMS/therapy; HORMONES; NEOPLASMS; THYMUS; IMMUNITY; LYMPHOCYTES; THERAPY

34565 (INIS-BR–1516, pp. 60) **Fase II-Combined treatment of malignant gliomas by surgery + radiotherapy + chemotherapy.** Guzman M, C.A.; Claverie, S. Sociedade Brasileira de Cancerologia, Salvador, BA (Brazil). 1988. (In Spanish). (CONF-8810366–: 2. Iberian-American congress of oncology, Salvador, Brazil, 9-14 Oct 1988). In *Proceedings of the 2. Iberian-American Congress of Oncology*. Order Number DE89613927/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

GLIOMAS/radiotherapy; CHEMOTHERAPY; GLIOMAS; RADIOTHERAPY; SURGERY

34566 (INIS-BR–1516, pp. 61) **Tumours of posterior fossa. Revision of 38 patients.** Pinel, M.I.S; Campos, L.S. de; Mendes, M.C.R.; Vieira, F.R. Sociedade Brasileira de Cancerologia, Salvador, BA (Brazil). 1988. (In Portuguese). (CONF-8810366–: 2. Iberian-American congress of oncology, Salvador, Brazil, 9-14 Oct 1988). In *Proceedings of the 2. Iberian-American Congress of Oncology*. Order Number DE89613927/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

NEOPLASMS/radiotherapy; CENTRAL NERVOUS SYSTEM; NEOPLASMS; RADIOTHERAPY; SKULL

34567 (INIS-BR–1516, pp. 68) **Medroxyprogesterone acetate: low x high dosis in advanced cancer of prostate (previously treated).** Guzman M, C.A. (Hospital Privado, Buenos Aires (Argentina). Inst. Medicos Antartida); Claverie, S. Sociedade Brasileira de Cancerologia, Salvador, BA (Brazil). 1988. (In Spanish). (CONF-8810366–: 2. Iberian-American congress of oncology, Salvador, Brazil, 9-14 Oct 1988). In *Proceedings of the 2. Iberian-American Congress of Oncology*. Order Number DE89613927/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

CARCINOMAS/prostate; CARCINOMAS/therapy; CARCINOMAS; PROSTATE; THERAPY; PROGESTERONE; SURGERY

34568 (INIS-BR–1516, pp. 70) **Assay in fase II with Iphosphamide. Results of 136 patients.** Gonzalez B, M. (Hospital La Paz, Madrid (Spain). Servicio de Oncologia Medica); Garcia G, C.; Jalon, J.I.; Paredes, M.L.G. de; Ordonez, A.; Felin, J.; Vicente, J.; Artal, A. Sociedade Brasileira de Cancerologia, Salvador, BA (Brazil). 1988. (In Spanish). (CONF-8810366–: 2. Iberian-American congress of oncology, Salvador, Brazil, 9-14 Oct 1988). In *Proceedings of the 2. Iberian-American Congress of Oncology*. Order Number DE89613927/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

CHEMOTHERAPY/neoplasms; CHEMOTHERAPY; NEOPLASMS; RADIOTHERAPY

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CARCINOMAS/lungs; CARCINOMAS; LUNGS; CHEMOTHERAPY; RADIOTHERAPY

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CARCINOMAS/mammary glands; CARCINOMAS; CHEMOTHERAPY; RADIOTHERAPY; SURVIVAL CURVES; SURVIVAL TIME

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NEOPLASMS/testes; CHEMOTHERAPY; EXTERNAL IRRADIATION; NEOPLASMS; TESTES; RADIOTHERAPY; SURGERY

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NEOPLASMS/male genitals; NEOPLASMS/radiotherapy; NEOPLASMS; RADIOTHERAPY; SURGERY; UROGENITAL SYSTEM DISEASES

34573 (INIS-BR–1516, pp. 89) **Nasopharynx carcinoma. Revision of 79 cases treated by radiotherapy.** Neves, M. (Instituto Portugues de Oncologia, Lisbon); Catita, J. Sociedade Brasileira de Cancerologia, Salvador, BA (Brazil). 1988. (In Portuguese). (CONF-8810366–: 2. Iberian-American congress of oncology, Salvador, Brazil, 9-14 Oct 1988). In *Proceedings of the 2. Iberian-American Congress of Oncology*. Order Number DE89613927/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

CARCINOMAS/pharynx; CARCINOMAS/radiotherapy; CARCINOMAS; PHARYNX; RADIOTHERAPY; EXTERNAL IRRADIATION; SURVIVAL TIME

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NEOPLASMS/salivary glands; COMPARATIVE EVALUATIONS; NEOPLASMS; RADIOTHERAPY; SURGERY

34575 (INIS-BR–1516, pp. 92) **Results of 3 years of radiochemotherapeutic treatment in advanced tumours (O.R.L.).** Lanzos, E.; Pena, C.; Murillo, M.T.; Escutia, P.; Bartolome, A.; Perez T, A. Sociedade Brasileira de Cancerologia, Salvador, BA (Brazil). 1988. (In Portuguese). (CONF-8810366–: 2. Iberian-American congress of oncology, Salvador, Brazil, 9-14 Oct 1988). In *Proceedings of the 2. Iberian-American Congress of Oncology*. Order Number DE89613927/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

NEOPLASMS/radiotherapy; CHEMOTHERAPY; NEOPLASMS; RADIOTHERAPY; SURGERY

34576 (INIS-BR–1516, pp. 98) **Melanoma: evaluation of 101 cases.** Bizzo, S. (Hospital de Oncologia, Rio de Janeiro, RJ (Brazil)); Buarque, E.J.; Guarischi, A.; Rondineli, R.; Kanashiro, P.; Mello, F.; Bezerra, F. Sociedade Brasileira de Cancerologia, Salvador, BA (Brazil). 1988. (In Portuguese). (CONF-8810366–: 2.

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RADIOTHERAPY/melanomas; CHEMOTHERAPY; FRACTIONATED IRRADIATION; RADIOTHERAPY; MELANOMAS; SURGERY

34577 (INIS-BR–1516, pp. 8) **Intersitial irradiation in brain tumours.** Correia, A.; Veras, G.; Pereira, J.C.; Hunhevicz, S. Sociedade Brasileira de Cancerologia, Salvador, BA (Brazil). 1988. (In Portuguese). (CONF-8810366–: 2. Iberian-American congress of oncology, Salvador, Brazil, 9-14 Oct 1988). In *Proceedings of the 2. Iberian-American Congress of Oncology*. Order Number DE89613927/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

RADIOTHERAPY/internal irradiation; RADIOTHERAPY/neoplasms; BRAIN; CESIUM 137; IRRADIATION CAPSULES; RADIATION SOURCE IMPLANTS; RADIOTHERAPY; NEOPLASMS

34578 (INIS-BR–1516, pp. 49) **^{192}Ir interstitial radiotherapy of carcinoma of inferior lip.** Ferreira, A.; Amaral, A.; Trindade, M.C.; Assuncao, D. Sociedade Brasileira de Cancerologia, Salvador, BA (Brazil). 1988. (In Portuguese). (CONF-8810366–: 2. Iberian-American congress of oncology, Salvador, Brazil, 9-14 Oct 1988). In *Proceedings of the 2. Iberian-American Congress of Oncology*. Order Number DE89613927/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

RADIOTHERAPY/carcinomas; RADIOTHERAPY/oral cavity; EXTERNAL IRRADIATION; INTERNAL IRRADIATION; IRIDIUM 192; RADIOTHERAPY; CARCINOMAS

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RADIOTHERAPY/carcinomas; RADIOTHERAPY/tongue; EXTERNAL IRRADIATION; INTERNAL IRRADIATION; IRIDIUM 192; RADIOTHERAPY; CARCINOMAS; TONGUE

34580 (INIS-BR–1516, pp. 120) **Operable breast carcinoma, mammary image techniques: sensitivity, specificity and prognostic value.** Spitalier, J.M.; Amalric, R.; Braudone, H.; Ayme, Y.; Giraud, D.; Marsella, L.T. Sociedade Brasileira de Cancerologia, Salvador, BA (Brazil). 1988. (In Spanish). (CONF-8810366–: 2. Iberian-American congress of oncology, Salvador, Brazil, 9-14 Oct 1988). In *Proceedings of the 2. Iberian-American Congress of Oncology*. Order Number DE89613927/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

IMAGES/diagnostic techniques; IMAGES/neoplasms; NEOPLASMS/mammary glands; COMPARATIVE EVALUATIONS; DIAGNOSIS; IMAGES; NEOPLASMS

34581 (INIS-BR–1516, pp. 125) **Breast cancer. Indicators of untouchable mammary lesions.** Kessler, Y. Sociedade Brasileira de Cancerologia, Salvador, BA (Brazil). 1988. (In Portuguese). (CONF-8810366–: 2. Iberian-American congress of oncology, Salvador, Brazil, 9-14 Oct 1988). In *Proceedings of the 2. Iberian-American Congress of Oncology*. Order Number DE89613927/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

NEOPLASMS/diagnosis; NEOPLASMS/mammary glands; BIOMEDICAL RADIOGRAPHY; IMAGES; NEOPLASMS; DIAGNOSIS; ULTRASONIC WAVES

34582 (INIS-BR–1516, pp. 129) **Glucagonoma-about a case.** Moura, A.C. de (Instituto Nacional do Cancer, Rio de Janeiro, RJ (Brazil)); Piva, N.; Nascimento, A.G. do. Sociedade Brasileira de Cancerologia, Salvador, BA (Brazil). 1988. (In Portuguese). (CONF-8810366–: 2. Iberian-American congress of oncology, Salvador, Brazil, 9-14 Oct 1988). In *Proceedings of the 2. Iberian-American Congress of Oncology*. Order Number DE89613927/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

NEOPLASMS/pancreas; ARTERIES; BIOMEDICAL RADIOGRAPHY; COMPUTERIZED TOMOGRAPHY; DIAGNOSIS; NEOPLASMS; PANCREAS

34583 (INIS-BR–1516, pp. 122) **Application of studies of liver perfusion in the diagnosis of secondary tumours of the liver.** Vieira, M.R.; Nogueira, A.R. Sociedade Brasileira de Cancerologia, Salvador, BA (Brazil). 1988. (In Portuguese). (CONF-8810366–: 2. Iberian-American congress of oncology, Salvador, Brazil, 9-14 Oct 1988). In *Proceedings of the 2. Iberian-American Congress of Oncology*. Order Number DE89613927/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

NEOPLASMS/diagnosis; NEOPLASMS/liver; IMAGES; METASTASES; NEOPLASMS; DIAGNOSIS; LIVER; TECHNETIUM

34584 (INIS-BR–1516, pp. 123) **Diffuse hyperfixation in brainpain in bone scintigraphy in patients with breast carcinoma. Retrospective evaluation in 648 patients.** Rodrigues, M.; Salgado, L.; Dias, M.; Vieira, M.R. Sociedade Brasileira de Cancerologia, Salvador, BA (Brazil). 1988. (In Portuguese). (CONF-8810366–: 2. Iberian-American congress of oncology, Salvador, Brazil, 9-14 Oct 1988). In *Proceedings of the 2. Iberian-American Congress of Oncology*. Order Number DE89613927/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

CARCINOMAS/mammary glands; SCINTISCANNING/skull; CARCINOMAS; DIAGNOSIS; METASTASES; SCINTISCANNING; SKULL

34585 (INIS-BR–1516, pp. 123) **Immunoscintigraphy with monoclonal antibodies antimelanoma. Evaluation of initial 5 cases.** Nogueira, A.R.; Vieira, M.R. and others. Sociedade Brasileira de Cancerologia, Salvador, BA (Brazil). 1988. (In Portuguese). (CONF-8810366–: 2. Iberian-American congress of oncology, Salvador, Brazil, 9-14 Oct 1988). In *Proceedings of the 2. Iberian-American Congress of Oncology*. Order Number DE89613927/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

MONOCLONAL ANTIBODIES/melanomas; MONOCLONAL ANTIBODIES/scintiscanning; SCINTISCANNING/monoclonal antibodies; DIAGNOSIS; MELANOMAS; SCINTISCANNING; TECHNETIUM 99

34586 (INIS-BR–1516, pp. 124) **Value of CA 125 in diagnosis and evaluation of clinical evolution of ovary carcinoma. Comparison with results from CA 19-9 and CEA.** Rodrigues, M.; Ramos, M.G.; Vieira, M.R. Sociedade Brasileira de Cancerologia, Salvador, BA (Brazil). 1988. (In Portuguese). (CONF-8810366–: 2. Iberian-American congress of oncology, Salvador, Brazil, 9-14 Oct 1988). In *Proceedings of the 2. Iberian-American Congress of Oncology*. Order Number DE89613927/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

ANTIGENS/comparative evaluations; CARCINOMAS/ovaries; ANTIGENS; CARCINOMAS; OVARIES; RADIOIMMUNOASSAY

34587 (INIS-BR–1516, pp. 100) **Radiotherapy in malignant melanomas (ORL) - Report of a case.** Jorge, L.; Trindade, M.C.; Patricio, M.B. Sociedade Brasileira de Cancerologia, Salvador, BA (Brazil). 1988. (In Portuguese). (CONF-8810366–: 2. Iberian-American congress of oncology, Salvador, Brazil, 9-14 Oct 1988). In *Proceedings of the 2. Iberian-American Congress of Oncology*. Order Number DE89613927/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

MELANOMAS/nose; MELANOMAS/radiotherapy; COBALT; MELANOMAS; NOSE; RADIOTHERAPY; SURGERY

34588 (INIS-BR–1516, pp. 100) **Retrospective revision of melanomas treated at Radiotherapy Department of Lisboa Center of Instituto Portugues de Oncologia de Francisco Gentil (IPOFG), during 25 years.** Trindade, M.C.; Patricio, M.B.; Jorge, L.; Vilhena, M. de. Sociedade Brasileira de Cancerologia, Salvador, BA (Brazil). 1988. (In Portuguese). (CONF-8810366–: 2. Iberian-American congress of oncology, Salvador, Brazil, 9-14 Oct 1988). In *Proceedings of the 2. Iberian-American Congress of Oncology*. Order Number DE89613927/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

MELANOMAS/radiotherapy; MELANOMAS; RADIOTHERAPY; SURGERY

34589 (INIS-BR–1516, pp. 101) **Ewing Sarcoma in infancy. The role of radiotherapy in the multidisciplinary treatment.** Gotardo, S.M.T.N.; Maia, M.A.C.; Novaes, P.E.R.S.; Trippe, N.; Peres, O.; Petrilli, A.S. Sociedade Brasileira de Cancerologia, Salvador, BA (Brazil). 1988. (In Portuguese). (CONF-8810366–: 2. Iberian-American congress of oncology, Salvador, Brazil, 9-14 Oct 1988). In *Proceedings of the 2. Iberian-American Congress of Oncology*. Order Number DE89613927/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

SARCOMAS/radiotherapy; CHEMOTHERAPY; SARCOMAS; RADIOTHERAPY; SURGERY

34590 (INIS-BR–1516, pp. 101) **Multidisciplinary treatment of orbital sarcomas in childhood.** Novaes, P.E.R.S.; Gianotti, C.B.A.; Gotardo, S.M.T.N.; Melaragno, R. Sociedade Brasileira de Cancerologia, Salvador, BA (Brazil). 1988. (In Portuguese). (CONF-8810366–: 2. Iberian-American congress of oncology, Salvador, Brazil, 9-14 Oct 1988). In *Proceedings of the 2. Iberian-American Congress of Oncology*. Order Number DE89613927/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

SARCOMAS/eyes; SARCOMAS/radiotherapy; CHEMOTHERAPY; INFANTS; LOCAL IRRADIATION; SARCOMAS; EYES; RADIOTHERAPY; SURGERY

34591 (INIS-BR–1516, pp. 102) **Radiotherapeutic treatment in carcinoma of nasopharynx in children.** Valdes Z, M. Sociedade Brasileira de Cancerologia, Salvador, BA (Brazil). 1988. (In Spanish). (CONF-8810366–: 2. Iberian-American congress of oncology, Salvador, Brazil, 9-14 Oct 1988). In *Proceedings of the 2. Iberian-American Congress of Oncology*. Order Number DE89613927/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

CARCINOMAS/pharynx; CARCINOMAS/radiotherapy; CARCINOMAS; PHARYNX; RADIOTHERAPY; CHEMOTHERAPY; CHILDREN

34592 (INIS-BR–1516, pp. 103) **Irradiation extended to skull in parameningeal sarcomas in children.** Valdes Z, M. Sociedade Brasileira de Cancerologia, Salvador, BA (Brazil). 1988. (In Spanish). (CONF-8810366–: 2. Iberian-American congress of oncology, Salvador, Brazil, 9-14 Oct 1988). In *Proceedings of the 2. Iberian-American Congress of Oncology*. Order Number DE89613927/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

SARCOMAS/meninges; SARCOMAS/radiotherapy; CENTRAL NERVOUS SYSTEM; CHEMOTHERAPY; CHILDREN; SARCOMAS; MENINGES; RADIOTHERAPY; SKULL

34593 (INIS-BR–1516, pp. 105) **Treatment of first line in 43 cases of immunocytoma.** Perez F, R.; Carrion G, J.R. and others. Sociedade Brasileira de Cancerologia, Salvador, BA (Brazil). 1988. (In Spanish). (CONF-8810366–: 2. Iberian-American congress of oncology, Salvador, Brazil, 9-14 Oct 1988). In *Proceedings of the 2. Iberian-American Congress of Oncology*. Order Number DE89613927/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

NEOPLASMS/radiotherapy; CHEMOTHERAPY; NEOPLASMS; RADIOTHERAPY; SURGERY

34594 (INIS-BR–1516, pp. 110) **Treatment of carcinoma of breast stage III in patients up to 60 years.** Palomero P, I.; Alonso M, A.; Estecha M, S.; Lopez C, C. Sociedade Brasileira de Cancerologia, Salvador, BA (Brazil). 1988. (In Spanish). (CONF-8810366–: 2. Iberian-American congress of oncology, Salvador, Brazil, 9-14 Oct 1988). In *Proceedings of the 2. Iberian-American Congress of Oncology*. Order Number DE89613927/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

CARCINOMAS/mammary glands; CARCINOMAS/radiotherapy; CARCINOMAS; RADIOTHERAPY; CHEMOTHERAPY; COBALT 60; COMPARATIVE EVALUATIONS; ELDERLY PEOPLE

34595 (INIS-BR–1516, pp. 111) **Inflammatory carcinoma of breast. Analysis of a multidisciplinary treatment.** Bohn, U. (Hospital Universitario San Carlos, Madrid (Spain). Servicio de Oncologia Medica); Gonzalez L, J.L.; Casado, A.; Garcia del M, J.; Almenares, J.; Martin J, M.; Diaz-Rubio, E. Sociedade Brasileira de Cancerologia, Salvador, BA (Brazil). 1988. (In Spanish). (CONF-8810366–: 2. Iberian-American congress of oncology, Salvador, Brazil, 9-14 Oct 1988). In *Proceedings of the 2. Iberian-American Congress of Oncology*. Order Number DE89613927/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

CARCINOMAS/mammary glands; CARCINOMAS; CHEMOTHERAPY; INFLAMMATION; LOCAL IRRADIATION; RADIOTHERAPY; SURGERY

34596 (INIS-BR–1516, pp. 113) **Association of radiotherapy and chemotherapy in treatment of epidermoide carcinoma of esophagus.** Buarque, E.J. (Hospital de Oncologia, Rio de Janeiro, RJ (Brazil)); Guarischi, A.; Loureiro, J. Sociedade Brasileira de Cancerologia, Salvador, BA (Brazil). 1988. (In Portuguese). (CONF-8810366–: 2. Iberian-American congress of oncology, Salvador, Brazil, 9-14 Oct 1988). In *Proceedings of the 2. Iberian-American Congress of Oncology*. Order Number DE89613927/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

CARCINOMAS/esophagus; CARCINOMAS; ESOPHAGUS; CHEMOTHERAPY; RADIOTHERAPY

34597 (INIS-BR–1516, pp. 116) **Analysis of multidisciplinary therapeutics of advanced cancer of ovary.** Queiroz Marques, E. de; Oliveira Trigueiro, E. de; Coelho, M.A.; Narahashi, H.; Rego Cavalcanti, Z. do. Sociedade Brasileira de Cancerologia, Salvador, BA (Brazil). 1988. (In Portuguese). (CONF-8810366–: 2. Iberian-American congress of oncology, Salvador, Brazil, 9-14 Oct 1988). In *Proceedings of the 2. Iberian-American Congress of Oncology*. Order Number DE89613927/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

NEOPLASMS/ovaries; CHEMOTHERAPY; EXTERNAL IRRADIATION; NEOPLASMS; OVARIES; RADIOTHERAPY; SURGERY

34598 (INIS-BR–1516, pp. 127) **Epidemiologic and clinical aspects. Follow-up of 287 cases of invasive uterine cervix carcinoma, Stage I.** Costa, O.L.N. (Hospital Aristides Maltez, Salvador, BA (Brazil)). Sociedade Brasileira de Cancerologia, Salvador, BA (Brazil). 1988. (In Portuguese). (CONF-8810366–: 2. Iberian-American congress of oncology, Salvador, Brazil, 9-14 Oct 1988). In *Proceedings of the 2. Iberian-American Congress of Oncology*. Order Number DE89613927/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

CARCINOMAS/urogenital system diseases; CARCINOMAS; EPIDEMIOLOGY; RADIOTHERAPY; SURGERY

34599 (INIS-BR–1516, pp. 138) **Ewing's tumour. Results of combined treatment.** Motta, N.W. da; Barletta, A.; Vauthier, G.; Sandri, A. Sociedade Brasileira de Cancerologia, Salvador, BA (Brazil). 1988. (In Portuguese). (CONF-8810366–: 2. Iberian-American congress of oncology, Salvador, Brazil, 9-14 Oct 1988). In *Proceedings of the 2. Iberian-American Congress of Oncology*. Order Number DE89613927/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

SARCOMAS/radiotherapy; CHEMOTHERAPY; SARCOMAS; RADIOTHERAPY

34600 (INIS-BR–1516, pp. 142) **Pre-operative chemotherapy in epidermoid carcinoma of thoracic esophagies.** Mello, E.L.R. de; Buarque, E.; Atalecio, E.; Malvezzi, A.; Kanashiro, P.; Guarischi, A. Sociedade Brasileira de Cancerologia, Salvador, BA (Brazil). 1988. (In Portuguese). (CONF-8810366–: 2. Iberian-American congress of oncology, Salvador, Brazil, 9-14 Oct 1988). In *Proceedings of the 2. Iberian-American Congress of Oncology*. Order Number DE89613927/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

CARCINOMAS/esophagus; CARCINOMAS; ESOPHAGUS; CHEMOTHERAPY; RADIOTHERAPY

34601 (INIS-BR–1516, pp. 150) **Adriamycin + cyclephosphamide in advanced cancer of breast.** Balana Q, C.; Salvador, L. Sociedade Brasileira de Cancerologia, Salvador, BA (Brazil). 1988. (In Spanish). (CONF-8810366–: 2. Iberian-American congress of oncology, Salvador, Brazil, 9-14 Oct 1988). In *Proceedings of the 2. Iberian-American Congress of Oncology*. Order Number DE89613927/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

CARCINOMAS/mammary glands; CARCINOMAS; CHEMOTHERAPY; METASTASES; RADIOTHERAPY

34602 (INIS-BR–1516, pp. 154) **Frequency of other neoplasias in multiple myeloma (MM).** Gonzalez, B.M.; Felin, J. and others. Sociedade Brasileira de Cancerologia, Salvador, BA (Brazil). 1988. (In Spanish). (CONF-8810366–: 2. Iberian-American congress of oncology, Salvador, Brazil, 9-14 Oct 1988). In *Proceedings of the 2. Iberian-American Congress of Oncology.* Order Number DE89613927/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

NEOPLASMS/response modifying factors; BIOLOGICAL EFFECTS; CHEMOTHERAPY; NEOPLASMS; RADIOTHERAPY

34603 (INIS-BR–1516, pp. 156) **Radiotherapy-association of pelvic cobalt teletherapy, local endocuretherapy in stabilizer treatment of cancer of canal anal.** Raynal, M. Sociedade Brasileira de Cancerologia, Salvador, BA (Brazil). 1988. (In Portuguese). (CONF-8810366–: 2. Iberian-American congress of oncology, Salvador, Brazil, 9-14 Oct 1988). In *Proceedings of the 2. Iberian-American Congress of Oncology.* Order Number DE89613927/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

RADIOTHERAPY/comparative evaluations; RADIOTHERAPY/neoplasms; INTERNAL IRRADIATION; IRIDIUM 192; LOCAL IRRADIATION; PELVIS; RADIOTHERAPY; NEOPLASMS; RECTUM

34604 (INIS-BR–1516, pp. 122) **Doses absorbed by the thyroid of patients under treatment with specific monoclonal antibodies from lymphoma of B cells and labelled with I 131.** Nogueira, A.R.; Denardo, G.; Macey, D. Sociedade Brasileira de Cancerologia, Salvador, BA (Brazil). 1988. (In Portuguese). (CONF-8810366–: 2. Iberian-American congress of oncology, Salvador, Brazil, 9-14 Oct 1988). In *Proceedings of the 2. Iberian-American Congress of Oncology.* Order Number DE89613927/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

MONOCLONAL ANTIBODIES/immunotherapy; MONOCLONAL ANTIBODIES/lymphomas; IODINE 131; LYMPHOCYTES; IMMUNOTHERAPY; LYMPHOMAS; RADIATION DOSES; THYROID

34605 (INIS-BR–1516, pp. 124) **Comparative evaluation between gammagraphy with 131-I-MIBG and other auxiliary methods of diagnosis in neuroblastoma patients. Six months of experience.** Ferreira, T.C.; Nogueira, A.C. and others. Sociedade Brasileira de Cancerologia, Salvador, BA (Brazil). 1988. (In Portuguese). (CONF-8810366–: 2. Iberian-American congress of oncology, Salvador, Brazil, 9-14 Oct 1988). In *Proceedings of the 2. Iberian-American Congress of Oncology.* Order Number DE89613927/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

NEOPLASMS/nervous system diseases; CAT SCANNING; COMPARATIVE EVALUATIONS; DIAGNOSIS; IODINE 131; NEOPLASMS; SCINTISCANNING

34606 (INIS-mf–11404 S9) **Diagnosis and differential diagnosis of disturbed portal circulation using serial computerized tomography.** Kloeppel, R. (3526512DD); Schulz, H.G. Humboldt-Universitaet, Berlin (German Democratic Republic). Bereich Medizin (Charite). 1988. (In German). (CONF-8810355–: Charite-symposium 'CT and MR in medicine', Berlin, German Democratic Republic, 17-18 Oct 1988). In *Abstracts of the Charite-symposium 'CT and MR in medicine'.* Order Number DE89613927/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

PORTAL SYSTEM/computerized tomography; LIVER CIRRHOSIS; LYMPHOMAS; SPLEEN

34607 (INIS-mf–11961) **Scintiscan studies as well as clinical and laboratory examinations to evaluate the therapeutic success achieved with gold salts and D-penicillamine in rheumatoid arthritis.** Doerwald, K. Kiel Univ. (Germany, F.R.). Medizinische Fakultaet. 25 Nov 1986. 52p. (In German). Order Number DE89783071/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

Comparative evaluations of findings revealed by semiquantitative scintiscanning using 99m-Tc pyrophosphate and the results of relevant clinical examinations and determinations of the blood sedimentation rate were carried out as part of a follow-up study in 35 patients treated for rheumatoid arthritis. Their reliability was judged as follows: (1) Inflamed joints were easily discernable on the scintiscans, which permitted a more accurate diagnosis to be made than the clinical findings. (2) The methods under investigation led to largely consistent results, as far as medical surveillance and predictions of patient outcome were concerned. (3) On the basis of a six-month observation period the therapeutic strategies followed (gold salts and D-penicillamine) were considered to be equally effective, the dose regimes being adapted to the individual requirements. (TRV).

34608 (INIS-mf–11962) **Radioimmunological determination of 5a-pregnane-3,20-dione and progesterone in arterial and venous blood from the umbilical cord.** Tannich, E. Tuebingen Univ. (Germany, F.R.). Medizinische Fakultaet. 1985. 59p. (In German). Order Number DE89783072/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

Radioimmunological investigations of arterial and venous blood from the umbilical cord for 5a-DHP and progesterone were carried out in 60 newly delivered infants using ^{3}H as a tracer substance. The following findings were revealed: (1) The correlation between progesterone and 5a-DHP was better in the venous blood than in the arterial blood from the umbilical cord and the concentrations measured for the two hormones were higher in the vein. (2) Both the umbilical vein and artery showed more elevated hormone levels in male infants as compared to female infants. (3) The duration of gestation, the concentration of hydrogen ions in the fetal plasma and various other maternal and fetal factors have an influence on the height of the 5a-DHP and progesterone levels in the umbilical blood. This was also concluded from the fact that the (arterial and venous) hormone concentrations measured in infants from primiparae were higher than those in infants from multiparae. The metabolisation of 5a-DHP varies between the sexes, which does not hold true for progosterone. (TRV).

34609 (INIS-mf–11963) **Role of scintiscan studies of the esophagus in the diagnosis of related functional disorders.** Seidl, I. Muenchen Univ. (Germany, F.R.). Fakultaet fuer Medizin. 14 Nov 1985. 164p. (In German). Order Number DE89783073/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

Radionuclide studies of the esophagus (by measuring the passage of a bolus of 99m-Tc DTPA and subsequent reflux tests) were carried out in a cohort of 248 patients, where the underlying pathological changes varied between individuals. In terms of sensitivity, this method was superior to mere reflux measurements and long-term pH determinations - just as well as to histological, endoscopic and simple X-ray examinations. Disorders of the esophageal function can mostly not be predicted from the clinical symptoms and signs alone. if esophageal function studies are combined with radionuclide examinations of gastric emptying, esophageal disorders are revealed in about 50% of cases showing deviations of the gastric emptying rate in either direction. It deserves to be mentioned here that this is quite independent of the level of gastric secretion. The results obtained have shown that esophageal function studies in combination with reflux tests are an invaluable technique of screening for esophageal function disorders. (TRV).

34610 (INIS-mf–11964) **Results achieved in the treatment of carcinomas of the thyroid gland. Case reports collected between 1951 and 1982 at the Radiological Institute of Tuebingen.** Ruhland, H. Tuebingen Univ. (Germany, F.R.). Medizinische Fakultaet. 1984. 83p. (In German). Order Number DE89783074/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

After statistical analysis of the results of treatment (drawn from case reports and data collected over 31 years, which were investigated for histological findings, five-year survival rates, sex and age distributions, formation of metastases), the author came to the following conclusions: (1) Total strumectomy was the most succesful method of treatment. (2) In papillary tumours, 131-radioiodine led to the best results that were quite independent of the patient's age. It is of particular note that no further metastases appeared in those cases where metastatisation could be kept under control for the first two years. (3) Controversial findings were revealed as to the therapeutic success in follicular carcinomas. (4) Huethle's oncocytoma rather appears to be of a benign nature, major therapeutic problems are posed by anaplastic tumours. Further surgical measures are

recommended to be taken especially in tumours showing structural differentiation. (TRV).

34611 (INIS-mf–11965) **Radioimmunological determination of plasma cortisol following application of a stomatic paste containing prednisolone (Dontisolon).** Stehn, H. Kiel Univ. (Germany, F.R.). Medizinische Fakultaet. 26 Feb 1985. 40p. (In German). Order Number DE89783075/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

A radioimmunological method was used to determine the cortisol plasma levels of 69 patients, treated with a stomatic paste containing prednisolone. Significant changes in plasma cortisol were only established in connection with a dose regimen of 3 times 1.25 mg daily. In isolated cases, however, there were major decreases in response to exposure to prednisolone. Therefore, the anamnestic data of any one patient being prescribed corticoids must be examined with care. (TRV).

34612 (INIS-mf–11966) **Quantitative scintiscanning in the follow-up observation of carcinomas of the breast. A correlation of results thus obtained with X-ray and laboratory findings to evaluate the effects of local irradiation or cytostatics.** Bauer, U. Muenchen Univ. (Germany, F.R.). Fakultaet fuer Medizin. 14 Nov 1985. 64p. (In German). Order Number DE89783076/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

Scintiscan studies using 99m-Tc methylene diphosphonate and the region-of-interest technique were carried out in order to obtain additional quantitative data on bone metastases that had already been confirmed by X-rays. Different degrees of density allowed to calculate the quotient of the ratio between bones and soft tissues. Changes in the behaviour of this quotient were found to provide information relevant to the value of chemotherapy or irradiation. Reduced quotients were interpreted as being a sign of a favourable response to treatment. One major drawback of this quotient is that it cannot be used without restriction for all kinds of therapy of laboratory examinations to assess the progress or remission of bone metastases. Nevertheless, it seems a meaningful parameter in the surveillance of patients receiving cytostatics or radiotherapy. (TRV).

34613 (INIS-mf–11968) **Concentrations of testosterone, luteal hormone and prolactin in the serum as well as comparisons of sensitivity between radioimmunoassays and enzyme assays for the detection of acid prostate phosphatase in the presence of carcinomas of the prostate.** Vopelius-Feldt, F. von. Technische Univ. Muenchen (Germany, F.R.). Fakultaet fuer Medizin. 14 May 1986. 106p. (In German). Order Number DE89783078/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

The relationship between carcinomas of the prostate and the plasma levels of testosterone, luteal hormone and prolactin as well as the possible influence of these neoplasms on the testosterone binding capacity and free testosterone index are investigated for various tumour stages and degrees of histological differentiation, in connection with several forms of local therapy as well as a variety of contrasexual methods. The sensitivity of enzyme assays and radioimmunoassays for the detection of acid prostate phosphatase is evaluated within the framework of this study. (MBL).

34614 (INIS-mf–11969) **Beta-endorphin in the plasma: Radioimmunological determination and findings in patients showing disorders at the level of the hypothalamus-pituitary-adrenal axis.** Hoerl, A. Muenchen Univ. (Germany, F.R.). Fakultaet fuer Medizin. 19 Dec 1985. 70p. (In German). Order Number DE89783057/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

Beta-endorphin and adrenocorticotropic hormone (ACTH) were determined simultaneously in the plasma using a radioimmunological procedure. It was found that in patients showing imbalances within the hypothalamus-pituitary-adrenal system (Addison's disease, Cushing's Syndrome, Nelson's Syndrome) as well as elevated levels of beta-endorphin the values of ACHT invariably were also increased. The behaviour of the plasma levels of beta-endorphin and ACTH before, during and subsequent to hypophyseal surgery gives evidence to prove the close link between the two hormones. Tests performed to examine the function of the corticotropin releasing factor (CRF) both in healthy volunteers and patients suffering from endocrinological disorders likewise pointed to a parallel behaviour pattern of the two hormones in their responding or failure to respond to stimulation. The fact that a significant correlation was established between all measured values of beta-endorphin and ACTH is further evidence in confirmation of a parallel release of these two hormones in man. (TRV).

34615 (INIS-mf–11970) **On the prevention of cutaneous injuries caused by radiotherapy of carcinomas of the breast. Examinations in patients treated at the Robert Janker Hospital at Bonn.** Pischnamazzadeh-Hedjabi, M. Freie Univ. Berlin (Germany, F.R.). 30 Jun 1983. 68p. (In German). Order Number DE89783058/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

A longitudinal, randomised study was carried out to assess the efficacy of O-(beta-hydroxyethyl)-rutoside (HR), when used as a radioprotective substance in radiotherapy of carcinomas of the breast. A total of 62 patients were included in the study and randomly assigned to one treatment group and one control group, each of which consisted of 31 patients. Except for the use of HR, the therapeutic strategies followed in the two study groups were identical. The protective effect against radiation-induced cutaneous injuries seen under treatment with Venoruton attained statistical significance as proven by the Chi-square test. Undesirable manifestations attributable to the test substance could not be observed, the only exception being one allergic reaction. It is reasonably safe to assume that there are no further protective influences of the substance on the tumour tissue.

34616 (INIS-mf–11971) **12500 E heparin and 12500 E of a semisynthetic heparin analogue (SSHA) in preventing thrombosis during radiotherapy of gynaecological carcinomas.** Hilscher, T.M. Muenchen Univ. (Germany, F.R.). Fakultaet fuer Medizin. 6 Oct 1983. 107p. (In German). Order Number DE89783059/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

The effects of 12500 E calcium heparin given once daily were contrasted with those seen under daily treatment with 12500 E of a semisynthetic heparin analogue (SSHA) and evaluated using iodine-125-labelled fibrinogen. The study included 80 patients, who were randomly assigned to the two treatment groups on a 1:1 basis. The findings revealed here led to the conclusion that both drugs, administered once daily by the subcutaneous route, were effective in preventing the occurrence of thrombosis during radiation treatment of gynaecological tumours.

34617 (INIS-mf–11973) **Kinetic behaviour of radioiodines accumulating in recurrent thyroid carcinomas and their metastases and the role of substituted thyroid hormones during radioiodine treatment.** Ensle, W. Tuebingen Univ. (Germany, F.R.). Medizinische Fakultaet. 1986. 58p. (In German). Order Number DE89783061/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

The relationship between the kinetic behaviour of radioiodines accumulating in recurrent thyroid tumours or their metastases and the role of substituted thyroid hormones was examined in 2 groups of patients undergoing radioiodine treatment, one of which additionally received thyroid hormones, while no such treatment was carried out in the other one. Two computer-assisted, whole body scintiscan studies (days 2 and 4) were performed so as to permit quantitative evaluation of the region of interest. The effective half-lives derived from this this procedure were longer for the patients receiving no thyroid hormones, pointing to a more beneficial effect of radioiodine treatment in this group. This leads to the conclusion that in patients receiving radioiodine therapy in order to control the spread of thyroid carcinomas, thyroid hormones should not be substituted until the cessation of this treatment. (TRV).

34618 (INIS-mf–11974) **Steroid hormones and peptide hormones in atopic eczema. Radioimmunological determination of diurnal plasma level variations of testosterone, cortisol, prolactin and human growth factor in healthy volunteers and patients showing atopic eczemae.** Bock, B. Erlangen-Nuernberg Univ., Erlangen (Germany, F.R.). Medizinische Fakultaet. 5 Jun 1986. 107p. (In German). Order Number DE89783062/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

An analysis of hormone measurements in sera from healthy volunteers and patients that was carried out on the basis of different criteria yielded the following results: (1) The testosterone levels determined in the patients sera were significantly lower than those of the healthy individuals and the daily rhythmic variations seen here did not attain statistical significance. (2) There were no statistically relevant differences in the serum concentrations of cortisol between healthy individuals and patients, nor was the amplitude of the daily variations observed to be changed in a consistent way. (3) In the patients, as compared to the healthy individuals, the prolactin level was considerably increased, as was the amplitude of the daily rhythmic variations. (4) The values determined for the human growth hormone (HCG) varied considerably between the individuals of either group. Since this held true for both the fluctuations with time and the height of the serum concentrations, a statistical analysis of the results appeared pointless. The results confirm that central and autonomous components have an important role in ectopic eczemae. (TRV).

34619 (INIS-mf–11975) **Comparative evaluation of two radioenzymatic procedures designed to determine noradrenaline in the plasma (COMT assay and PNMT assay).** Barth, A. Koeln Univ. (Germany, F.R.). Medizinische Fakultaet. 12 Apr 1984. 89p. (In German). Order Number DE89783063/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

A comparative evaluation of two radioenzymatic procedures to determine the concentration of noradrenaline in the plasma - with linearity, sensitivity, specifity and accuracy serving as test criteria - led to the following results: In view of a probability of error in the order of 2% both methods were judged to show a satisfactory sensitivity. The specific of the COMT assay, by contrast with that of the PNMT assay, was found to be wanting, as the noradrenaline measurements in the presence of other biogenic amines were biassed in such a way that the values determined were higher than the actual concentrations. During antihypertensive treatment even minimal changes in the noradrenaline concentration can be ascertained on a quantitative basis. If suitable hardware is available, the COMT assay permits up to 25 single determinations to be carried out per day, while the number of double determinations is restricted to 7 per day. One advantage, however, lies in the fact that several catecholamines in the plasma can be detected simultaneously, if required. In cases where the noradrenaline concentration alone is to be determined for clinical purposes, preference should be given to the PNMT assay, as both tests showed equal linearity and sensitivity. (TRV).

34620 (INIS-mf–11976) **Can the diagnostic accuracy of radionuclide ventriculography during exercise be improved by means of a step-up loading procedure?.** Ruegenberg, T. Frankfurt Univ. (Germany, F.R.). Fachbereich Humanmedizin. 17 Sep 1985. 37p. (In German). Order Number DE89783064/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

34 patients (31 of whom were coronary heart disease sufferers as proven by angiography) and further 3 patients failing to show symptoms of this disorder were subjected to radionuclide ventriculography carried out with the aid of ^{99m}Tc-labelled erythrocytes in such a way that examinations at rest were directly followed by maximum loading tests. In a second series of examinations a step-up procedure was adopted where initial recordings at rest were followed by preliminary exercise tests using only 25% of the maximum load. The parameters chosen to evaluate the results were heart rate, ejection fraction, maximum velocity of changes in volume, endsystolic and enddiastolic volumes (ESV and EDV) as well as cardiac output. In 23 patients the preliminary exercise test revealed an insufficient increase or even decrease of the ejection fraction that was associated with delayed volume changes, increases in ESV and EDV as well as reductions in cardiac output and in 21 patients it became evident during those examinations that the onset of stenocardiac complaints was preceded by markedly pronounced function disorders in the left ventricle. It was concluded from these findings that the step-up procedure followed here may in some patients provide additional information on the level of myocardial performance. It can thus be assumed to contribute considerably to higher diagnostic accuracy, although it requires no more time than conventional exercise tests and is not associated with additional radiation exposure. (TRV).

34621 (INIS-mf–11977) **Autoradiographic investigations of cells from the cerebrospinal fluid.** Thamm, W. Freie Univ. Berlin (Germany, F.R.). 29 Jun 1983. 83p. (In German). Order Number DE89783065/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

A total of 155 samples of cerebrospinal fluid obtained from 61 patients were subjected to cytological examination and incubated together with $_3{}^1$H-thymidine. Radioactive labelling was thus achieved for lymphocytes, monocytes and tumour cells. The highest contents of radioactivity were seen in tumour cells. To a lesser degree had the isotope become attached to the lymphocytes, while the tendency to take up radioactivity was lowest in cells from autochthonous tumours of the brain. In cerebral and meningeal metastases the labelling index rose proportionately to the progress of the disease. Autoradiography can be used to monitor cytostatic treatment carried out to control the spread of meningeal carcinoma cells. In non-inflammatory disorders, lymphocytes and monocytes of the cerebrospinal fluid only rarely show radioactivity. A suprisingly high labelling index was determined for lymphocytes and monocytes of cerebrospinal fluid from young children, which was considered to be attributable to the high proliferation rates to be expected here.

34622 (INIS-mf–11978) **Radioimmunological detection of vasopressin in urine extracts.** Buengner, R. Hamburg Univ. (Germany, F.R.). Fachbereich 4 Medizin. 4 Nov 1983. 74p. (In German). Order Number DE89783066/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

After initial measures had been taken to ensure that ion exchange chromatography would yield a sufficiently high recovery of labelled and non-labelled hormone as well as to eliminate all intervening factors it was possible to use the described extraction procedure in connection with the RIA introduced by Freisenhausen et al. At the clinical level, the technique was employed to assess the post-operative release of AVP (argenine vasopressin) in 24-hour urine samples obtained from patients subjected to hypophysectomy. In a total of 10 patients, where hypophysectomy had been performed for different clinical reasons, the AVP values were seen to be significantly decreased for the first three hours after surgical intervention. They recovered slightly during the following three hours to remain at an average level of 2 pg /400 μl urine. The extraction procedure described can be used to determine levels of AVP approaching the limit of detection - either due to large volumes of urine or very low concentrations of AVP.

34623 (INIS-mf–11979) **Echocardiography, ventriculography and coronary angiography in patients just recovering from acute myocardial infarction.** Goetz, S. Muenchen Univ. (Germany, F.R.). Fakultaet fuer Medizin. 13 Jan 1983. 85p. (In German). Order Number DE89783067/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

Comparative evaluations were carried out on the basis of ventriculography, echocardiography and corornary angiography that would permit to throw some light on the following issues: Can the changes in overall ventricular function occurring in response to the processes in the infarcted zone be visualised by means of M-mode scans. Which degree of accuracy can be achieved, if attempts are made to establish an echocardiographic diagnosis on the basis of M-mode scans in order to confirm regional contractility disorders revealed by ventriculography.

34624 (INIS-mf–11981) **Cardiac function studies. Refinement of a computer-assisted programme designed to be used on a routine basis in connection with the first-pass technique with 99m-Tc human serum albumin as tracer.** Horn, H.J. Tuebingen Univ. (Germany, F.R.). Medizinische Fakultaet. 1986. 54p. (In German). Order Number DE89783069/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

A total of 27 patients were subjected tointramyocardial sequential scintiscanning (first pass) using 99m-Tc human serum albumin. A refined method is described that is suitable to analyse clinically relevant parameters like blood volume, cardiac output, ejection fraction, stroke volume, enddiastolic and endsystolic volumes as well as pulmonal transition time and uses a complete camaracomputer system adapted to the requirements of a routine procedure. Unless there is special hardware available, the method does not yet appear mature

enough to be put into general practice. Its importance recently appeared in a new light due to the advent of particularly shortlived isotopes. For the time being, however, ECG-triggered equilibrium studies are to be preferred for cardiac function tests. (TRV).

34625 (NAC–88-01) **Neutron dosimetry measurements at the MRC cyclotron unit, Clatterbridge Hospital, U.K.** Jones, D.T.L.; Blake, S.W. Council for Scientific and Industrial Research, Faure (South Africa). National Accelerator Centre. 1988. 15p. Available from the CSIR, National Accelerator Centre, P.O. Box 72, Faure, 7131, South Africa.

A neutron dosimetry intercomparison study undertaken at the Medical Research Council's neutron therapy facility at Clatterbridge Hospital, Merseyside, U.K. is reported. Measurements were made with ostensible identical NAC and MRC tissue equivalent ionization chambers. For the NAC chamber used the photon calibration was essentially identical to the measurement made at NAC. In the p(62 MeV)/Be (36 MeV) neutron beam dose measurements made with the NAC ionization chamber were between 0.6% and 1.0% (average 0.8%) higher than those made with the MRC ionization chamber. The results are satisfactory and the differences are well within expected deviation specified in international protocols. The differences can possibly largely be ascribed to incorrect geometrical correction factors. Measurements of the ratio of the responses measured with tissue equivalent gas and air filling agree well with each other and with theoretical calculations.

34626 (NAC–88-02) **Neutron dosimetry intercomparison study with tissue equivalent ionization chambers: National Accelerator Centre and Universite Catholique de Louvain, Belgium.** Vynckier, S.; Jones, D.T.L. Council for Scientific and Industrial Research, Faure (South Africa). National Accelerator Centre. 1988. 30p. Available from the CSIR, National Accelerator Centre, P.O. Box 72, Faure, 7131, South Africa.

The results of a neutron dosimetry intercomparison study undertaken at the Universite Catholique de Louvain, Belgium are reported. The results show excellent agreement between the different tissue equivalent ionization chambers used. The photon calibration factors measured differ from those previously determined by a maximum of 0.14%. For the measurement of total dose in a p(65 MeV)/Be(35 MeV) neutron therapy beam the maximum deviation from the measured mean is 0.48% for all conditions. For the NAC chamber used the photon calibration differed by 0.11% from the measurement made at NAC, while the average deviation from the mean for the neutron beam measurements was 0.10%.

34627 (NAC-RR–664) **Comparison of the gamma component of two high energy neutron therapy beams.** Jones, D.T.L.; Vynckier, S.; Yudelev, M. Council for Scientific and Industrial Research, Stellenbosch (South Africa). National Accelerator Centre. Dec 1988. 22p. Available from the National Accelerator Centre, Foundation for Research Development, CSIR, P.O. Box 72, Faure, 7131, South Africa.

Reciprocal neutron dosimetry intercomparison have been undertaken between the National Accelerator Centre (NAC), South Africa and the Universite Catholique de Louvain (UCL), Belgium. A comparison of the gamma components measured in the respective therapy beams using the classic twin-detector method formed part of the study. The gamma component under various irradiation conditions was derived from pairs of measurements with tissue equivalent ionization chambers and Geiger-Mueller (GM) counters. The gamma component expressed as a fraction of the gamma dose relative to the total dose agreed within less than 0.01, with the measurements with the NAC GM counters being consistently higher than those with the UCL counter. These differences are attributed to errors in the measurement of the neutron sesnitivities of the GM counters. The results obtained are nevertheless highly satisfactory in view of the complexity and difficulty of the measurements.

34628 (NAC-RR–665) **Field factors for the NAC p(66 MeV)/Be neutron therapy beam.** Jones, D.T.L.; Yudelev, M. Council for Scientific and Industrial Research, Stellenbosch (South Africa). National Accelerator Centre. Feb 1989. 60p. Available from the National Accelerator Centre, Foundation for Research Development, CSIR, P.O. Box 72, Faure, 7131, South Africa.

Output factors have been measured for a range of field sizes and beam filter combinations in the NAC p(66)/Be neutron therapy beam. Polynomial functions were fitted to the square-field data and filter factors, wedge factors and backscatter factors were derived from the measured data by dividing the relevant fitted polynomials on a point-by-point basis.

34629 (PNL–6250) **Projection of needs for gamma radiation sources and other radioisotopes and assessment of alternatives for providing radiation sources.** Ross, W.A.; Jensen, G.A.; Clark, L.L.; Eakin, D.E.; Jarrett, J.H.; Katayama, Y.B.; McKee, R.W.; Morgan, L.G.; Nealey, S.M.; Platt, A.M. Pacific Northwest Lab., Richland, WA (USA). Jun 1989. 113p. Sponsored by DOE Nuclear Energy. DOE Contract AC06-76RL01830. Order Number DE89012874/JAW. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

Pacific Northwest Laboratory reviewed the projected uses and demands for a variety of nuclear byproducts. Because the major large-scale near-term demand is for gamma irradiation sources, this report concentrates on the needs for gamma sources and evaluates the options for providing the needed material. Projections of possible growth in the irradiation treatment industry indicate that there will be a need for 180 to 320 MCi of ^{60}Co (including ^{137}Cs equivalent) in service in the year 2000. The largest current and projected use of gamma irradiation is for the sterilization of medical devices and disposable medical supplies. Currently, 40% of US disposable medical products are treated by irradiation, and within 10 years it is expected that 90% will be treated in this manner. Irradiation treatment of food for destruction of pathogens or parasites, disinfestation, or extension of allowable storage periods is estimated to require an active inventory of 75 MCi of ^{60}Co-equivalent gamma source in about a decade. 90 refs., 7 figs., 25 tabs.

34630 **Recent developments in neutron capture therapy.** Fairchild, R.G. (Brookhaven National Lab., Upton, NY (USA)); Slatkin, D.N.; Coderre, J.; Micca, P.; Laster, B.; Som, P.; Wheeler, F.; Kahl, S.B.; Fand, I. *Strahlentherapie und Onkologie (F.R. Germany),* 165(4): 343-347 (Apr 1989). DOE Contract AC02-76CH00016. (CONF-8710474–: EORTC-Heavy Particles Therapy Group meeting, Muenchen, Germany, F.R., 16-17 Oct 1987).

The conditions for the possible initiation of clinical trials with neutron capture therapy at a number of locations in the U.S. is reviewed. There are several new technical developments or plans at the Brookhaven Medical Research Reactor (BMRR), the Power Burst Facility (PBF) at INEL, the Massachusetts Institute of Technology Reactor (MITR) and the Georgia Institute of Technology Research Reactor (GTRR). Emphasis is on the development of epithermal beams for the treatment of deepseated tumors with neutron fluxes in between 10^9 to 10^{10} n/cm^{2}s. Therapeutic dose gains, defined as the ratio of tumour dose to maximum normal tissue dose in the treatment volume are expected to be between 2 and 4, depending on the degree of suppression of fast neutron dose. Boron concentrations considered in this case in the tumour are around 35 μg ^{10}B/g and tumour/normal tissue concentrations are around 10. The compound development throughout three generations is discussed. The compound proposed nowadays, $Na_2B_{12}H_{11}SH$ (or BSH), employed in the treatments in Japan, will likely be replaced in the future by analogous of biomolecules being enriched in the tumour by physiological pathways. Examples are p-boronophenylalanine or boronated porphyrius. The most promising solution envisaged would be the employment of tumour cell specific boronated monoclonal antibodies. Finally the mode of therapy is discussed which will likely be based on a fractioned scheme, to achieve optimized results.

5507 Microbiology

Refer also to citation(s) 33384, 34667

5509 Pathology

Refer also to citation(s) 34519, 34708, 34709

5510 Physiological Systems

Refer also to citation(s) 35505

5520 Public Health

Refer also to citation(s) 33168, 33169, 33170, 34387, 34388, 34389, 34390, 34391, 34392, 34393, 34394, 34395, 34396, 34397, 34398, 34399, 34400, 34401, 34402, 34403, 34404, 34405, 34408, 34409, 34410, 34411, 34412, 34413, 34416, 34417, 34418, 34419, 34420, 34421, 34422, 34423, 34709

34631 (PB–89-139224/XAB) **NIOSH (National Institute for Occupational Safety and Health) testimony to DOL (Department of Labor) on the Occupational Safety and Health Administration's proposed rule on the control of hazardous energy sources (lockout/tagout) by R. W. Niemeier, September 8, 1988.** National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). 8 Sep 1988. 7p. Available from NTIS, PC A02/MF A01.

The testimony addressed the proposed rule on control of hazardous energy sources and was offered in support of the position of the Occupational Safety and Health Administration on this issue. Provisions already in existence for cranes, derricks, and power presses require lockout provisions for electrical connections. The proposed rule will extend these protections to nonelectric power sources and add a requirement for isolating nonelectric hazards. The new rule requires a written procedure and training program. NIOSH opposed the use of tags instead of locks, as tags only provide a warning and are subject to several abuses including removal before maintenance is complete and negligence in removing the tag by the service operator when maintenance is completed. Over 20 electrically related fatalities were noted where a deenergized locked-out electrical circuit would have prevented the fatality. In a review of 160 responses concerning injuries where the equipment was turned off, six indicated the equipment was tagged out. Concern was also expressed over the simple tagout permitted for mechanical power transmission systems. NIOSH recommends that each worker should apply and remove his or her own lock.

5530 Agriculture and Food Technology

Refer also to citation(s) 33388, 34415

34632 (IAEA-TECDOC–496) **Improvement of crops in Africa through the use of induced mutations. Report of a regional seminar held in Lusaka, Zambia, 20-24 June 1988.** International Atomic Energy Agency, Vienna (Austria); Food and Agriculture Organization of the United Nations, Rome (Italy). Feb 1989. 59p. (CONF-8806372–: Regional seminar on improvement of crops in Africa through the use of induced mutations, Lusaka, Zambia, 20-24 Jun 1988). Order Number DE89618013/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

This report is a summary of the lectures and abstracts of the reports presented at the seminar. Refs and tabs.

34633 (IAEA-TECDOC–496, pp. 11-13) **Role of induced mutations for crop improvement.** Micke, A. (Joint FAO/IAEA Div. of Isotope and Radiation Applications of Atomic Energy for Food and Agricultural Development, Vienna (Austria)). International Atomic Energy Agency, Vienna (Austria); Food and Agriculture Organization of the United Nations, Rome (Italy). Feb 1989. (CONF-8806372–: Regional seminar on improvement of crops in Africa through the use of induced mutations, Lusaka, Zambia, 20-24 Jun 1988). In *Improvement of crops in Africa through the use of induced mutations. Report of a regional seminar held in Lusaka, Zambia, 20-24 June 1988.* Order Number DE89618013/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

PLANT BREEDING/mutants; GENETICS; HYBRIDIZATION; MUTAGENESIS; MUTANTS; PLANTS; PRODUCTIVITY

34634 (IAEA-TECDOC–496, pp. 14-15) **Mutation breeding for crop improvement in India.** Bhatia, C.R. (Bhabha Atomic Research Centre, Bombay (India). Nuclear Agriculture Div.). International Atomic Energy Agency, Vienna (Austria); Food and Agriculture Organization of the United Nations, Rome (Italy). Feb 1989. (CONF-8806372–: Regional seminar on improvement of crops in Africa through the use of induced mutations, Lusaka, Zambia, 20-24 Jun 1988). In *Improvement of crops in Africa through the use of induced mutations. Report of a regional seminar held in Lusaka, Zambia, 20-24 June 1988.* Order Number DE89618013/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

PLANT BREEDING/mutants; CROPS; MUTAGENESIS; MUTAGENS; MUTATIONS; MUTANTS; PLANTS; PRODUCTIVITY

34635 (IAEA-TECDOC–496, pp. 16-19) **Contribution of mutagenesis to the development of improved varieties in Italy.** Donini, B. (ENEA, Casaccia (Italy). Dept. of Agrobiotechnologies). International Atomic Energy Agency, Vienna (Austria); Food and Agriculture Organization of the United Nations, Rome (Italy). Feb 1989. (CONF-8806372–: Regional seminar on improvement of crops in Africa through the use of induced mutations, Lusaka, Zambia, 20-24 Jun 1988). In *Improvement of crops in Africa through the use of induced mutations. Report of a regional seminar held in Lusaka, Zambia, 20-24 June 1988.* Order Number DE89618013/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

MUTAGENESIS/plant breeding; CEREALS; FRUITS; HYBRIDIZATION; MUTAGENESIS; PLANTS; VEGETABLES

34636 (IAEA-TECDOC–496, pp. 20) **Factors limiting production of rice in the People's Republic of Benin.** Pedro, J. (Ministry of Rural Development and Co-operation, Cotonou (Benin). Directorate of Agronomic Research). International Atomic Energy Agency, Vienna (Austria); Food and Agriculture Organization of the United Nations, Rome (Italy). Feb 1989. (CONF-8806372–: Regional seminar on improvement of crops in Africa through the use of induced mutations, Lusaka, Zambia, 20-24 Jun 1988). In *Improvement of crops in Africa through the use of induced mutations. Report of a regional seminar held in Lusaka, Zambia, 20-24 June 1988.* Order Number DE89618013/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

RICE/productivity; CROPS; CULTIVATION TECHNIQUES; DISEASE RESISTANCE; IRRIGATION; MUTANTS; RICE; PRODUCTIVITY

34637 (IAEA-TECDOC–496, pp. 21-23) **Rice varietal improvement in Sierra Leone: An experience with the use of induced mutations.** Mansaray, M.S. (Rice Research Station, Freetown (Sierra Leone). Plant Breeding Div.); Monde, S.S.; Hilton-Lahai, A.H. International Atomic Energy Agency, Vienna (Austria); Food and Agriculture Organization of the United Nations, Rome (Italy). Feb 1989. (CONF-8806372–: Regional seminar on improvement of crops in Africa through the use of induced mutations, Lusaka, Zambia, 20-24 Jun 1988). In *Improvement of crops in Africa through the use of induced mutations. Report of a regional seminar held in Lusaka, Zambia, 20-24 June 1988.* Order Number DE89618013/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

RICE/radiation induced mutants; CULTIVATION TECHNIQUES; DISEASE RESISTANCE; ECOSYSTEMS; FUNGI; MUTAGENESIS; PRODUCTIVITY; RICE; SOILS

34638 (IAEA-TECDOC–496, pp. 24) **National crop problems and potential solutions by plant breeding with reference to rice.** Ching'ang'a, H.M. (TARO, Dar-es-Salaam (Tanzania)). International Atomic Energy Agency, Vienna (Austria); Food and Agriculture Organization of the United Nations, Rome (Italy). Feb 1989. (CONF-8806372–: Regional seminar on improvement of crops in Africa through the use of induced mutations, Lusaka, Zambia, 20-24 Jun 1988). In *Improvement of crops in Africa through the use of induced mutations. Report of a regional seminar held in Lusaka, Zambia, 20-24 June 1988.* Order Number DE89618013/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

PLANT BREEDING/mutants; CULTIVATION TECHNIQUES; DISEASE RESISTANCE; ECOSYSTEMS; PARASITES; MUTANTS; PRODUCTIVITY; RICE

34639 (IAEA-TECDOC–496, pp. 25) **Use of induced mutation in breeding rice for iron toxicity tolerance.** Abifarin, A.O. (International Inst. of Tropical Agriculture/West Africa Rice Development Association, Monrovia (Liberia)). International Atomic Energy Agency, Vienna (Austria); Food and Agriculture Organization of the

United Nations, Rome (Italy). Feb 1989. (CONF-8806372–: Regional seminar on improvement of crops in Africa through the use of induced mutations, Lusaka, Zambia, 20-24 Jun 1988). In *Improvement of crops in Africa through the use of induced mutations. Report of a regional seminar held in Lusaka, Zambia, 20-24 June 1988.* Order Number DE89618013/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

PLANT BREEDING/radiation induced mutants; TOXICITY/iron; MORPHOLOGICAL CHANGES; PRODUCTIVITY; RICE; SOILS; TOXICITY; IRON

34640 (IAEA-TECDOC–496, pp. 26) **Problems of increasing the yield of field and vegetable cowpeas and suggestions for a breeding strategy.** Uzo, J.O. (Nigeria Univ., Nsukka (Nigeria). Dept. of Crop Science); Ezueh, M.I. International Atomic Energy Agency, Vienna (Austria); Food and Agriculture Organization of the United Nations, Rome (Italy). Feb 1989. (CONF-8806372–: Regional seminar on improvement of crops in Africa through the use of induced mutations, Lusaka, Zambia, 20-24 Jun 1988). In *Improvement of crops in Africa through the use of induced mutations. Report of a regional seminar held in Lusaka, Zambia, 20-24 June 1988.* Order Number DE89618013/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

PEAS/plant breeding; DISEASE RESISTANCE; ECOSYSTEMS; MUTAGENESIS; MUTANTS; PEAS; PRODUCTIVITY

34641 (IAEA-TECDOC–496, pp. 27) **Grain legumes production problems in Kenya.** Omanga, P.A. (National Dryland Farming Research Centre, Machakos (Kenya)); Shakoor, A. International Atomic Energy Agency, Vienna (Austria); Food and Agriculture Organization of the United Nations, Rome (Italy). Feb 1989. (CONF-8806372–: Regional seminar on improvement of crops in Africa through the use of induced mutations, Lusaka, Zambia, 20-24 Jun 1988). In *Improvement of crops in Africa through the use of induced mutations. Report of a regional seminar held in Lusaka, Zambia, 20-24 June 1988.* Order Number DE89618013/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

Published in summary form only.

34642 (IAEA-TECDOC–496, pp. 28) **Soybean improvement research strategies in Uganda.** Gumisiriza, G. (Namulonge Research Station, Kampala (Uganda)). International Atomic Energy Agency, Vienna (Austria); Food and Agriculture Organization of the United Nations, Rome (Italy). Feb 1989. (CONF-8806372–: Regional seminar on improvement of crops in Africa through the use of induced mutations, Lusaka, Zambia, 20-24 Jun 1988). In *Improvement of crops in Africa through the use of induced mutations. Report of a regional seminar held in Lusaka, Zambia, 20-24 June 1988.* Order Number DE89618013/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

SOYBEANS/plant breeding; DISEASE RESISTANCE; ECOSYSTEMS; MORPHOLOGICAL CHANGES; MUTANTS; PRODUCTIVITY; SOYBEANS

34643 (IAEA-TECDOC–496, pp. 29) **Breeding soybeans for improved seed viability and promiscuous nodulation.** Safo-Kantanka, O. (University of Science and Technology, Kumasi (Ghana). Crop Science Dept.). International Atomic Energy Agency, Vienna (Austria); Food and Agriculture Organization of the United Nations, Rome (Italy). Feb 1989. (CONF-8806372–: Regional seminar on improvement of crops in Africa through the use of induced mutations, Lusaka, Zambia, 20-24 Jun 1988). In *Improvement of crops in Africa through the use of induced mutations. Report of a regional seminar held in Lusaka, Zambia, 20-24 June 1988.* Order Number DE89618013/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

SOYBEANS/plant breeding; MUTANTS; SEEDS; SOYBEANS; VIABILITY

34644 (IAEA-TECDOC–496, pp. 30) **Production of food legumes in Rwanda: Problems and possible solutions.** Nyabyenda, P. (Institut des Sciences Agronomiques du Rwanda (ISAR), Butare (Rwanda)). International Atomic Energy Agency, Vienna (Austria); Food and Agriculture Organization of the United Nations, Rome (Italy). Feb 1989. (CONF-8806372–: Regional seminar on improvement of crops in Africa through the use of induced mutations, Lusaka, Zambia, 20-24 Jun 1988). In *Improvement of crops in Africa through the use of induced mutations. Report of a regional seminar held in Lusaka, Zambia, 20-24 June 1988.* Order Number DE89618013/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

LEGUMINOSAE/productivity; CLIMATES; CULTIVATION TECHNIQUES; FUNGI; LEGUMINOSAE; PRODUCTIVITY; PARASITES; PLANT BREEDING; SOILS

34645 (IAEA-TECDOC–496, pp. 32) **Crop improvement programmes at Shambat, Sudan.** Abdelrahman, M.E. (Faculty of Agriculture, Shambat (Sudan). Dept. of Agronomy). International Atomic Energy Agency, Vienna (Austria); Food and Agriculture Organization of the United Nations, Rome (Italy). Feb 1989. (CONF-8806372–: Regional seminar on improvement of crops in Africa through the use of induced mutations, Lusaka, Zambia, 20-24 Jun 1988). In *Improvement of crops in Africa through the use of induced mutations. Report of a regional seminar held in Lusaka, Zambia, 20-24 June 1988.* Order Number DE89618013/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

BEANS/plant breeding; SORGHUM/plant breeding; BEANS; CLIMATES; CULTIVATION TECHNIQUES; MUTAGENESIS; MUTANTS; PARASITES; PRODUCTIVITY; SORGHUM

34646 (IAEA-TECDOC–496, pp. 33) **Application of induced mutation techniques in the improvement of yield of bambara groundnut (Voandzeia subterranea (L.) Thou).** Lungu, D.M. (Zambia Univ., Lusaka (Zambia). School of African Sciences); Mbewe, D.M.N. International Atomic Energy Agency, Vienna (Austria); Food and Agriculture Organization of the United Nations, Rome (Italy). Feb 1989. (CONF-8806372–: Regional seminar on improvement of crops in Africa through the use of induced mutations, Lusaka, Zambia, 20-24 Jun 1988). In *Improvement of crops in Africa through the use of induced mutations. Report of a regional seminar held in Lusaka, Zambia, 20-24 June 1988.* Order Number DE89618013/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

PLANT BREEDING/productivity; HYBRIDIZATION; MUTAGENESIS; MUTANTS; PRODUCTIVITY; PLANTS

34647 (IAEA-TECDOC–496, pp. 34) **Place for mutagenesis in sunflower for the subtropical Africa.** Mwala, M.S. (Mount Makulu Central Agricultural Research Station, Chilanga (Zambia)). International Atomic Energy Agency, Vienna (Austria); Food and Agriculture Organization of the United Nations, Rome (Italy). Feb 1989. (CONF-8806372–: Regional seminar on improvement of crops in Africa through the use of induced mutations, Lusaka, Zambia, 20-24 Jun 1988). In *Improvement of crops in Africa through the use of induced mutations. Report of a regional seminar held in Lusaka, Zambia, 20-24 June 1988.* Order Number DE89618013/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

SUNFLOWERS/plant breeding; HYBRIDIZATION; MUTAGENESIS; SUNFLOWERS

34648 (IAEA-TECDOC–496, pp. 35) **Disease problems in sunflower (Helianthus annus L.) and potential solutions by plant breeding through nuclear techniques.** Muunga, X.T. (Mount Makulu Central Agricultural Research Station, Chilanga (Zambia)). International Atomic Energy Agency, Vienna (Austria); Food and Agriculture Organization of the United Nations, Rome (Italy). Feb 1989. (CONF-8806372–: Regional seminar on improvement of crops in Africa through the use of induced mutations, Lusaka, Zambia, 20-24 Jun 1988). In *Improvement of crops in Africa through the use of induced mutations. Report of a regional seminar held in Lusaka, Zambia, 20-24 June 1988.* Order Number DE89618013/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

DISEASE RESISTANCE/radiation induced mutants; HYBRIDIZATION; PLANT BREEDING; PRODUCTIVITY; SUNFLOWERS

34649 (IAEA-TECDOC–496, pp. 36) **Maize research activities in Zambia.** Mwambula, C. (Mount Makulu Central Agricultural Research Station, Chilanga (Zambia)). International Atomic Energy Agency, Vienna (Austria); Food and Agriculture Organization of the United Nations, Rome (Italy). Feb 1989. (CONF-8806372–: Regional seminar on improvement of crops in Africa through the use of

induced mutations, Lusaka, Zambia, 20-24 Jun 1988). In *Improvement of crops in Africa through the use of induced mutations. Report of a regional seminar held in Lusaka, Zambia, 20-24 June 1988.* Order Number DE89618013/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

MAIZE/plant breeding; CLIMATES; DISEASE RESISTANCE; HYBRIDIZATION; INSECTS; MAIZE; PACKAGING; PRODUCTION

34650 (IAEA-TECDOC–496, pp. 37) **Maize breeding in the People's Republic of Benin.** Pedro, J. (Ministry of Rural Development and Co-operation, Cotonou (Benin). Directorate of Agronomic Research). International Atomic Energy Agency, Vienna (Austria); Food and Agriculture Organization of the United Nations, Rome (Italy). Feb 1989. (CONF-8806372–: Regional seminar on improvement of crops in Africa through the use of induced mutations, Lusaka, Zambia, 20-24 Jun 1988). In *Improvement of crops in Africa through the use of induced mutations. Report of a regional seminar held in Lusaka, Zambia, 20-24 June 1988.* Order Number DE89618013/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

MAIZE/plant breeding; CLIMATES; HYBRIDIZATION; INSECTS; MAIZE; PRODUCTIVITY

34651 (IAEA-TECDOC–496, pp. 38) **Genetic analysis of M_2 progenies derived from different doses of gamma irradiation of Malian sorghum strains and an American variety.** Bretaudeau, A. (Institut Polytechnique Rural, Koulikoro (Mali)); Coulibaly, F.; Traore, K.I. International Atomic Energy Agency, Vienna (Austria); Food and Agriculture Organization of the United Nations, Rome (Italy). Feb 1989. (CONF-8806372–: Regional seminar on improvement of crops in Africa through the use of induced mutations, Lusaka, Zambia, 20-24 Jun 1988). In *Improvement of crops in Africa through the use of induced mutations. Report of a regional seminar held in Lusaka, Zambia, 20-24 June 1988.* Order Number DE89618013/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

SORGHUM/plant breeding; DOSE-RESPONSE RELATIONSHIPS; GENETICS; HYBRIDIZATION; MORPHOLOGICAL CHANGES; MUTAGENESIS; RADIATION EFFECTS; RADIATION INDUCED MUTANTS; SORGHUM

34652 (IAEA-TECDOC–496, pp. 39) **Makerere tomato improvement programme.** Rubaihayo, P.R. (Makerere Univ., Kampala (Uganda). Dept. of Crop Science). International Atomic Energy Agency, Vienna (Austria); Food and Agriculture Organization of the United Nations, Rome (Italy). Feb 1989. (CONF-8806372–: Regional seminar on improvement of crops in Africa through the use of induced mutations, Lusaka, Zambia, 20-24 Jun 1988). In *Improvement of crops in Africa through the use of induced mutations. Report of a regional seminar held in Lusaka, Zambia, 20-24 June 1988.* Order Number DE89618013/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

TOMATOES/plant breeding; DISEASE RESISTANCE; MUTAGENESIS; MUTANTS; PARASITES; TOMATOES

34653 (IAEA-TECDOC–496, pp. 40) **Study on tolerance/resistance of tomato to attack by Pseudomonas solanacearum E.F. Smith.** Diallo, A. (Institute of Agricultural Sciences, Foulaya, Kindia (Guinea)). International Atomic Energy Agency, Vienna (Austria); Food and Agriculture Organization of the United Nations, Rome (Italy). Feb 1989. (CONF-8806372–: Regional seminar on improvement of crops in Africa through the use of induced mutations, Lusaka, Zambia, 20-24 Jun 1988). In *Improvement of crops in Africa through the use of induced mutations. Report of a regional seminar held in Lusaka, Zambia, 20-24 June 1988.* Order Number DE89618013/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

TOMATOES/plant breeding; TOMATOES/pseudomonas; DISEASE RESISTANCE; HYBRIDIZATION; INSECTS; MUTAGENESIS; MUTANTS; TOMATOES; PSEUDOMONAS

34654 (IAEA-TECDOC–496, pp. 41) **Breeding for acyanogenesis in cassava by mutation techniques.** Uzo, J.O. (Nigeria Univ., Nsukka (Nigeria). Dept. of Crop Science); Okereke, O.U. International Atomic Energy Agency, Vienna (Austria); Food and Agriculture Organization of the United Nations, Rome (Italy). Feb 1989. (CONF-8806372–: Regional seminar on improvement of crops in Africa through the use of induced mutations, Lusaka, Zambia, 20-24 Jun 1988). In *Improvement of crops in Africa through the use of induced mutations. Report of a regional seminar held in Lusaka, Zambia, 20-24 June 1988.* Order Number DE89618013/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

CASSAVA/cyanides; CASSAVA/plant breeding; CASSAVA; CYANIDES; MUTAGENESIS; RADIATION INDUCED MUTANTS

34655 (IAEA-TECDOC–496, pp. 42) **Root and tuber crop improvement at the University of Science and Technology, Kumasi.** Safo-Kantanka, O. (University of Science and Technology, Kumasi (Ghana). Crop Science Dept.). International Atomic Energy Agency, Vienna (Austria); Food and Agriculture Organization of the United Nations, Rome (Italy). Feb 1989. (CONF-8806372–: Regional seminar on improvement of crops in Africa through the use of induced mutations, Lusaka, Zambia, 20-24 Jun 1988). In *Improvement of crops in Africa through the use of induced mutations. Report of a regional seminar held in Lusaka, Zambia, 20-24 June 1988.* Order Number DE89618013/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

CASSAVA/plant breeding; YAMS/plant breeding; CASSAVA; DISEASE RESISTANCE; HYBRIDIZATION; INSECTS; MUTAGENESIS; MUTANTS; PRODUCTIVITY; YAMS

34656 (IAEA-TECDOC–496, pp. 43-45) **Cassava and sweet potato production constraints in Kenya.** Shakoor, A. (National Dryland Farming Research Centre, Machakos (Kenya)); Omanga, P.A.; Kiarie, A.W. International Atomic Energy Agency, Vienna (Austria); Food and Agriculture Organization of the United Nations, Rome (Italy). Feb 1989. (CONF-8806372–: Regional seminar on improvement of crops in Africa through the use of induced mutations, Lusaka, Zambia, 20-24 Jun 1988). In *Improvement of crops in Africa through the use of induced mutations. Report of a regional seminar held in Lusaka, Zambia, 20-24 June 1988.* Order Number DE89618013/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

CASSAVA/plant breeding; POTATOES/plant breeding; CASSAVA; CLIMATES; CULTIVATION TECHNIQUES; DISEASE RESISTANCE; HYBRIDIZATION; INSECTS; PARASITES; POTATOES; PRODUCTIVITY

34657 (IAEA-TECDOC–496, pp. 46) **Root and tuber crops production and research in Liberia.** Amet, T.M. (Liberia Univ., Monrovia (Liberia). Coll. of Agriculture and Forestry); As-Saqui, A. International Atomic Energy Agency, Vienna (Austria); Food and Agriculture Organization of the United Nations, Rome (Italy). Feb 1989. (CONF-8806372–: Regional seminar on improvement of crops in Africa through the use of induced mutations, Lusaka, Zambia, 20-24 Jun 1988). In *Improvement of crops in Africa through the use of induced mutations. Report of a regional seminar held in Lusaka, Zambia, 20-24 June 1988.* Order Number DE89618013/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

CASSAVA/plant breeding; CASSAVA/productivity; POTATOES/plant breeding; POTATOES/productivity; YAMS/plant breeding; YAMS/productivity; CASSAVA; PRODUCTIVITY; CLIMATES; CULTIVATION TECHNIQUES; DISEASE RESISTANCE; POTATOES; YAMS

34658 (IAEA-TECDOC–496, pp. 47) **Wild fruit tree crops in Zambia.** Mwamba, C.K. (National Council for Scientific Research, Kitwe (Zambia). Tree Improvement Research Centre). International Atomic Energy Agency, Vienna (Austria); Food and Agriculture Organization of the United Nations, Rome (Italy). Feb 1989. (CONF-8806372–: Regional seminar on improvement of crops in Africa through the use of induced mutations, Lusaka, Zambia, 20-24 Jun 1988). In *Improvement of crops in Africa through the use of induced mutations. Report of a regional seminar held in Lusaka, Zambia, 20-24 June 1988.* Order Number DE89618013/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

FRUIT TREES/plant breeding; CULTIVATION TECHNIQUES; FRUITS; PRODUCTIVITY

34659 (IAEA-TECDOC–496, pp. 48) **Preliminary results of radiosensitivity tests with Ricinodendron rautanenii Shinz. and Uapaca kirkiana (Muil.) Arg. fruit trees.** Chishimba, W.K.

(National Council for Scientific Research, Kitwe (Zambia). Tree Improvement Research Centre). International Atomic Energy Agency, Vienna (Austria); Food and Agriculture Organization of the United Nations, Rome (Italy). Feb 1989. (CONF-8806372–: Regional seminar on improvement of crops in Africa through the use of induced mutations, Lusaka, Zambia, 20-24 Jun 1988). In *Improvement of crops in Africa through the use of induced mutations. Report of a regional seminar held in Lusaka, Zambia, 20-24 June 1988.* Order Number DE89618013/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

FRUIT TREES/plant breeding; CULTIVATION TECHNIQUES; GAMMA RADIATION; HYBRIDIZATION; MORPHOLOGICAL CHANGES; OILS; RADIATION DOSES; RADIATION EFFECTS; RADIOSENSITIVITY

34660 (IAEA-TECDOC–496, pp. 49-50) **Mutation breeding using in vitro culture techniques.** Novak, F.J. (International Atomic Energy Agency, Seibersdorf (Austria). Laboratories). International Atomic Energy Agency, Vienna (Austria); Food and Agriculture Organization of the United Nations, Rome (Italy). Feb 1989. (CONF-8806372–: Regional seminar on improvement of crops in Africa through the use of induced mutations, Lusaka, Zambia, 20-24 Jun 1988). In *Improvement of crops in Africa through the use of induced mutations. Report of a regional seminar held in Lusaka, Zambia, 20-24 June 1988.* Order Number DE89618013/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

PLANT TISSUES/mutations; CELL CULTURES; GENETICS; IN VITRO; MUTAGENESIS; MUTAGENS; MUTATIONS; TISSUE CULTURES

34661 (IAEA-TECDOC–496, pp. 51-52) **Mutation breeding for disease resistance.** Murata, N. (Joint FAO/IAEA Div. of Isotope and Radiation Applications of Atomic Energy for Food and Agricultural Development, Vienna (Austria)). International Atomic Energy Agency, Vienna (Austria); Food and Agriculture Organization of the United Nations, Rome (Italy). Feb 1989. (CONF-8806372–: Regional seminar on improvement of crops in Africa through the use of induced mutations, Lusaka, Zambia, 20-24 Jun 1988). In *Improvement of crops in Africa through the use of induced mutations. Report of a regional seminar held in Lusaka, Zambia, 20-24 June 1988.* Order Number DE89618013/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

PLANTS/disease resistance; BACTERIA; ENVIRONMENT; FUNGI; GENETICS; MUTAGENESIS; MUTANTS; PLANTS; VIRUSES

34662 (IAEA-TECDOC–496, pp. 31) **Grain legumes research programme at Suakoko, Liberia. A review.** Emmanzi, W.K. (Central Agricultural Research Inst. (CARI), Suakoko (Liberia)); Voker, J.K.; Amet, T.M. International Atomic Energy Agency, Vienna (Austria); Food and Agriculture Organization of the United Nations, Rome (Italy). Feb 1989. (CONF-8806372–: Regional seminar on improvement of crops in Africa through the use of induced mutations, Lusaka, Zambia, 20-24 Jun 1988). In *Improvement of crops in Africa through the use of induced mutations. Report of a regional seminar held in Lusaka, Zambia, 20-24 June 1988.* Order Number DE89618013/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

LEGUMINOSAE/plant breeding; LEGUMINOSAE; MUTAGENESIS; MUTANTS; PRODUCTIVITY; RESEARCH PROGRAMS

34663 (ISH–118) **Effects of ionizing radiation on food, compared to the effects of conventional food treatment: A literature study. Pt. 1.** Leister, W.; Boegl, K.W. Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene. Aug 1987. 131p. (In German). Available from Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene.

The extent and quality of changes due to irradiation is described and compared with conventional methods. Effects of radiation treatment on vegetable products as well as pork, beef, any type of fish and poultry product are compared with conventional thermic, microwave or smoke treatments, drying processes, ethylene oxide gas treatment, as well as effects from storage, temperature and sealed packaging. In this context the influences of the different treatment methods on various food components and on sensory, physical-chemical or biochemical characteristics were compared. The following tendencies were observed: conventional treatment methods produce partly more pronounced changes than irradiation with standard doses. Heat treatment, for instance, results in a greater weight loss, in altered sugar content, and in higher content of carbonyl and aldehyde releasing compounds. Gas treatment will cut the volatile oil content in half, while it remains nearly constant after irradiation. However, in some cases, an irradiation with standard doses may cause changes which should not be disregarded. In onions, for instance, irradiation is causing a stronger decomposition during storage than only cold storage.

34664 (PB–89-136493/XAB) **Radioactivity in foods grown on Florida phosphate lands. Final report.** Guidry, J.J.; Bolch, W.E.; Roessler, C.E.; McClave, J.T.; Moon, J.R. Post, Buckley, Schuh and Jernigan, Inc., Orlando, FL (USA). Mar 1986. 192p. Available from NTIS, PC A09/MF A01.

This study involved radioactivity in foods grown on Florida phosphate lands. More than 90 land parcels in central Florida were identified and evaluated for potential food production. Over 100 food samples were collected from 62 of these land parcels and subjected to radioassay for isotopes of radium, uranium, and thorium. Corresponding soil samples were also collected and analyzed for radium-226 and pH. Statistical analysis of the radium-226 data has shown that the average concentrations exhibited by foods grown on mined lands was significantly higher than the average concentrations exhibited by foods grown on unmined lands. Descriptive analyses of the other radionuclides support the conclusion. A hypothetical individual who obtains 100% of the foods sampled in the study from mined lands and the remainder of his diet from the general food pool is estimated to receive 4 microrems per year in committed effective dose equivalent from ingestion of the radionuclides reported in the study. This is 0.3 microrems (8%) per year more than a similar individual who obtains 100% of the food sampled in the study from unmined lands. These dose levels are quite low and are not considered to be a health hazard.

34665 (Zfl-Mitt–138) **Radiation treatment of onions.** Huebner, G. (ed.). Akademie der Wissenschaften der DDR, Leipzig (German Democratic Republic). Zentralinstitut fuer Isotopen- und Strahlenforschung. Jun 1988. 215p. (In German). Order Number DE89619877/JAW. Available from NTIS (US Sales Only), PC A10/MF A01 - OSTI; INIS.

The comprehensive report comprises 15 papers closely related to the leading article. The irradiation of onions (Allium cepa L.) serves to prevent sprouting associated with long-term storage or transport and storage of onions in climatic conditions which stimulate sprouting. The papers contain results of physiological investigations on the optimum conditions for onion irradiation, and technical and economic parameters of the process under national economy and business management aspects. For two different types of irradiation plants, a bulk-type plant and a multi-purpose large-scale irradiation plant, technical specifications and economic results in relation to product throughput, loading and price of ^{60}Co are presented.

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5601 Radiation Effects

Refer also to citation(s) 34445, 34455, 34456, 34558, 34615, 34616

34666 (AD-A–200645/0/XAB) **Opposite effects of WR-2721 and WR-1065 on radiation-induced hypothermia: possible correlation with oxygen uptake. Scientific report.** Kandasamy, S.B.; Kumar, K.S.; Hunt, W.A.; Weiss, J.F. Armed Forces Radiobiology Research Inst., Bethesda, MD (USA). 1988. 9p. (AFRRI-SR–88-15). Available from NTIS, PC A02/MF A01.

Pub. in Radiation Research, Vol. 114, 240-247(1988).

Ionizing radiation induces hypothermia in guinea pigs. While systemic injection of the radioprotectant S-2-(3-aminopropylamimo)ethylphosphorothioic acid (WR-2721) did not block hypothermia induced by exposure to 10 Gy of gamma radiation, central administration did attenuate it. The dephosphorylated metabolite of WR-2721, N-(2-mercaptoethyl)-1,3-diaminopropane

(WR-1065), accentuated radiation-induced hypothermia by both routes of administration. In brain homogenates, oxygen uptake was inhibited by WR-2721 but elevated by WR-1065. These results suggest that the antagonism of radiation-induced hypothermia found only after central administration of WR-2721 is due to its direct actions and not in its dephosphorylated metabolite, and that this effect may be correlated with the inhibition by WR-2721 of oxygen uptake.

34667 (AD-A-201373/8/XAB) **Absence of transient elevated UV resistance during germination of 'Bacillus subtilis' spores lacking small, acid-soluble spore proteins alpha and beta.** Setlow, B.; Setlow, P. Connecticut Univ. Health Center, Farmington, CT (USA). Dept. of Biochemistry. Jun 1988. 3p. Available from NTIS, PC A02/MF A01.

Pub. in Jnl. of Bacteriology, Vol. 170, No. 6, 2858-2859(Jun 1988).

Germinating spores of Bacillus subtilis mutants that lack small, acid-soluble spore proteins alpha and beta did not exhibit the transient elevated UV resistance seen during germination of wild-type spores. Dormant spores of various Bacillus species are much more resistant to UV irradiation than are the corresponding vegetative cells. This elevated spore UV resistance appears to have two causes. First, UV irradiation of spores does not produce the pyrimidine dimers formed in vegetative-cell DNA, but rather produces several other photoproducts, the most predominant of which is termed the spore photoproduct, a 5-thyminyl-5,6-dihydrothymine adduct (1, 10). Second, spores have at least two mechanisms that efficiently repair this spore photoproduct during spore germination, including one that monomerizes the adduct back to two thymines.

34668 (AD-A-201399/3/XAB) **Dose-dependent changes in the antigenicity of bacterial endotoxin exposed to ionizing radiation. Report No. 2, 1986-1987.** Csako, G.; Suba, E.A.; Tsai, C.M.; Mocca, L.F.; Elin, R.J. Naval Medical Research Inst., Bethesda, MD (USA). 1987. 7p. Available from NTIS, PC A02/MF A01.

Pub. in Jnl. of Clinical Laboratory Immunology, Vol. 24, 193-198(1987).

The antigenic properties of the highly purified US reference standard endotoxin (RSE) exposed to varying doses of ionizing radiation were studied with double immuno-diffusion, immunoelectrophoresis, and immunoblotting. Rabbit RSE antisera identified 2 distinct major antigenic components for untreated RSE: one related to the O-polysaccharide side chain (O-antigenic specificity), the other to the R-core. Based on a serologic cross-reactivity of R-core of RSE (Escherichia coli 0113) with the R-core of the lipopolysaccharide from E. coli 0111, the core type of E. coli 0113 was identified as coli R3. Increasing exposure of RSE to ionizing radiation progressively destroyed all antigenic reactivities; at lower doses of radiation the rate of elimination differed for the 2 antigen classes. The O-polysaccharide was more sensitive to gamma radiation than the R-core and the O-antigenicity was lost before that of the R-core. Endotoxin molecules containing incomplete R-core (radiation-induced or mutant) did not react with the RSE antiserum. Keywords: Antigenicity, Reprints. (KT/KR)

34669 (CFFTP-G-87026) **Metabolism of tritium uptake due to handling of metal surfaces exposed to tritiated hydrogen gas.** Johnson, J.R.; Peterman, B.F. Canadian Commercial Corp., Ottawa, ON (Canada). Aug 1987. 19p. (AECL-9518). Order Number DE89619832/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Hairless rats were exposed to tritium by rubbing HT contaminated stainless steel planchets on them. The pattern of tritium excretion in the urine (n=4), shows the OBT (organically bound tritium) retention curve to be approximated by the sum of 2 exponential curves, one with a half-life of 0.4 days and another with a half-life of 1.4 days. The retention of HTO fit a single exponential curve with a half-life of 3.1 days. Exposed skin, unexposed skin, liver, muscle and blood (n=6) were assayed for HBO, and free HTO. Highest activity was found in the exposed skin, other organs with high activity are the unexposed skin and liver. Examination of the exposed skin showed HTO to be concentrated in the uppermost layers. The distribution of OBT was similar but was incorporated at a faster rate. The basal layer is exposed to a tritium concentration between 70-90% of that of the surface. The two macromolecule fractions with the highest amount of radioactivity were lipid and insoluble protein (mainly collagen).

34670 (CONF-890517-2) **Calculations of physical and chemical reactions with DNA in aqueous solution from Auger cascades.** Wright, H.A.; Hamm, R.N.; Turner, J.E.; Howell, R.W.; Rao, D.V.; Sastry, K.S.R. Oak Ridge National Lab., TN (USA). 1989. 17p. Sponsored by DOE Energy Research. DOE Contract AC05-84OR21400. From 10. symposium on microdosimetry; Rome, Italy; 21-26 May 1989. Order Number DE89013063/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Monte Carlo calculations are performed of the physical and chemical interactions in liquid water by electrons produced during Auger cascades resulting from the decay of various radionuclides. Estimates are also made of the number of direct physical and indirect chemical interactions that would be produced on DNA located near the decay site. 13 refs., 8 figs.

34671 (DOE/ER/60502-03) **The development of in vitro mutagenicity testing systems using T-lymphocytes: Research progress report: June 1, 1988-May 31, 1989.** Albertini, R.J. Vermont Univ., Burlington, VT (USA). May 1989. 29p. Sponsored by DOE Energy Research. DOE Contract FG02-87ER60502. Order Number DE89013800/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

We will summarize our refinement of the methodology for cloning human T-lymphocytes and quantifying in vivo T-cell mutant frequencies at the hprt locus. The ability to maintain in vitro proliferation of these cells allows molecular characterizations, including analyses of hprt outlined elsewhere, the latter permits definitions of mutation frequencies which underlie the measured mutant frequencies. This unique aspect of the T-lymphocyte cloning assay is extremely important because it permits quantitation of in vivo mutational events, which are the events of public health interest. An increase in in vivo mutational events is only one of the causes of increased mutant frequencies, the other is in vivo clonal expansions of mutant cells. Clonal expansions have an importance of their own, but the implications are different than for increases in mutations. Several examples of in vivo clonal expansions will de detailed. The ability to maintain in vitro proliferation of T-cell colonies also allows molecular analyses of the mutations in the hprt gene. The results of both southern blot analyses for gene deletions and rearrangements and direct sequencing for smaller changes such as base substitutions will be given. A spectrum of hprt mutations is being developed both for unexposed, "normal" humans as well as for humans exposed to ionizing irradiation in the course of radioimmunoglobulin therapy (RIT) for hepatoma treatment. 11 figs., 4 tabs.

34672 (FRNC-TH-3471) **Procedures for expressing natural or induced variability in carnation (Dianthus Caryophyllus L.).** Simard, M.H. CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France). Service de Radio-Agronomie; Paris-11 Univ., 91 - Orsay (France). Jan 1989. 250p. (In French). Order Number DE89781575/JAW. Available from NTIS (US Sales Only), PC A11/MF A01.

Mutagenesis (gamma rays) and in vitro organogenesis are used separately or both to diversify carnation varieties by revealing and creating variability. As regards to in vivo mutagenesis, an important diversification of the flower colour is obtained by applying a 60 Gray dose to two hundred rooted cuttings. The organogenesis ability has been tested among different types of explants. The petal of young floral bud shows the best caulogenesis capacities. The organogenesis region is located at the petal base. Histological studies reveal that neoformations are originated from epidermic and sub-epidermic cellular layers. The morphogenetic evolution of neoformations depends on growth factors imbalance. Isolated neoformations can grow in a vegetative way (vitrous plantlets) or in a reproductive one (petaloid structures). Modifications of the petal and neoformations culture conditions induce a normal development by preventing and suppressing vitrification. Histological studies show strong anatomic differences between vitrous and petaloid forms when compared to the normal ones. A method combining in vitro organogenesis and mutagenesis has been investigated. To avoid chimera, petals are irradiated the second day of culture (differentiated cells). A 20 or 40 Gray dose can be applied.

34673 (IAEA-R–3441-F) **Experiments on radionuclide accumulation by fishes from the Angra Dos Reis region of Brazil. Final report for the period 1 May - 15 September 1988.** Guimaraes, J.R.D. Instituto de Radioprotecao e Dosimetria, Rio de Janeiro, RJ (Brazil); International Atomic Energy Agency, Vienna (Austria). Nov 1988. 13p. Order Number DE89618008/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

To follow the bioaccumulation and tissue distribution of ^{137}Cs and ^{60}Co in fish from tropical waters near the Angra nuclear power station in Brazil, juvenile grouper (Epinephelus sp.) were exposed under laboratory conditions to Angra sea water containing the two radionuclides initially added in chloride form. During the 4-month exposure period, the sea water was not changed and the fish received regular rations of non-radioactive food. Following uptake, the fish were dissected and composite tissue samples monitored for radioactivity. ^{137}Cs concentration factors (CFs) were 3 and 5 in whole fish and muscle, respectively. The highest concentration of ^{137}Cs was found in the muscle which accounted for 66% of the total body burden. In contrast, the highest concentration and greatest fraction (19%) of ^{60}Co was located in the liver. Whole body and muscle CFs for ^{60}Co, 0.2 and 0.08 respectively, were much lower than those for ^{137}Cs. Compared with published data, only very small amounts of both radionuclides were taken up by bone in the present study. This observation and the fact that much higher ^{137}Cs CFs have been reported in fish from field studies suggests that uptake through the food chain is the principal pathway for bioaccumulation in nature. Elution of freshly-prepared and previously-used radioactive sea water through chelating resins indicated that ^{60}Co added in the cationic form was almost totally converted to neutral or anionic forms after four months. Additional experiments carried out with the previously-used experimental media demonstrated that the possibly ligand-bound ^{60}Co was approximately 2.5 times more available for uptake by grouper than the cationic forms initially present. It is concluded that the uptake of ^{60}Co by fish exposed to radioactive effluents would be a function of the different forms of ^{60}Co present.

34674 (IAEA-TECDOC–486, pp. 129-140) **Immunoadsorption of ABO antibodies: Results of in vitro, porcine in vivo and human ex vivo experimental phases.** Duval, D. (Compagnie ORIS Industrie, 91 - Gif-sur-Yvette (France)); Collin, C.; Gaussens, G.; Nicaise, M. International Atomic Energy Agency, Vienna (Austria). Dec 1988. (CONF-8706235–: 5. international conference on mechanical behaviour of materials, Beijing, China, 3-6 Jun 1987). In *Radiation technology for immobilization of bioactive materials. Proceedings of the final research co-ordination meeting held in Beijing, 15-18 June 1987.* Order Number DE89617908/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

An optimized polymerization in emulsion technique is described for producing microbeads that immobilize human red blood cells to allow formation of blood type antibody immunoadsorbents which can be used in an extra-corporeal circuit. Adsorption capacity and clinical compatibility of the immunoadsorbent were evaluated through three phases of experimentation: in vitro, in vivo on the pig and ex vivo with man. (author). 6 refs, 10 figs.

34675 (INFO–0260) **Catalogue of data on uranium intake, organ burden and excretion.** Atomic Energy Control Board, Ottawa, ON (Canada); Senes Consultants, Willowdale, ON (Canada). Nov 1987. 151p. Order Number DE89619828/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

The Atomic Energy Control Board is initiating the critical evaluation of current biokinetic and dosimetric models applicable to radiation workers exposed to the common chemical and physical forms of uranium that are encountered throughout the nuclear fuel cycle. The identification and location of the relevant sets of data are the first steps of this project. This report describes the collection methods used and presents catalogues of the data on human and animal studies that have resulted from exposures under controlled experimental conditions, chronic occupational or environmental situations and acute accidental conditions. The data was identified through the use of computerized literature searches of the BIOSIS, NTIS, MEDLINE and Occupational Safety and Health (NIOSH) data bases, library research and telephone contact with currently active researchers in the field. A table is presented which categorizes researchers in the field according to affiliation and country.

34676 (INIS-BR–1516, pp. 5) **Influence of total body irradiation on the appearing of tumours in mice.** Pereira, M.E.M.; Patricio, M.B.; Jorge, L.; Raposo, J.A.S.; Soares, J. Sociedade Brasileira de Cancerologia, Salvador, BA (Brazil). 1988. (In Portuguese). (CONF-8810366–: 2. Iberian-American congress of oncology, Salvador, Brazil, 9-14 Oct 1988). In *Proceedings of the 2. Iberian-American Congress of Oncology.* Order Number DE89613927/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

WHOLE-BODY IRRADIATION/mice; WHOLE-BODY IRRADIATION/neoplasms; BIOLOGICAL RADIATION EFFECTS; CARCINOGENS; COBALT 60; DOSE-RESPONSE RELATIONSHIPS; IN VIVO; RADIATION DOSES; MICE; NEOPLASMS

34677 (INIS-BR–1516, pp. 6) **Total body irradiation (TBI) in mice. Study of changes in several organs.** Jorge, L.; Patricio, M.B.; Raposo, J.A.S.; Pereira, M.E.; Soares, J. Sociedade Brasileira de Cancerologia, Salvador, BA (Brazil). 1988. (In Portuguese). (CONF-8810366–: 2. Iberian-American congress of oncology, Salvador, Brazil, 9-14 Oct 1988). In *Proceedings of the 2. Iberian-American Congress of Oncology.* Order Number DE89613927/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

WHOLE-BODY IRRADIATION/biological radiation effects; WHOLE-BODY IRRADIATION/mice; COBALT 60; IN VIVO; NEOPLASMS; ORGANS; MICE

34678 (INIS-BR–1516, pp. 7) **Multiple basilomas posroentgenotherapy.** Amaro, J.A. Sociedade Brasileira de Cancerologia, Salvador, BA (Brazil). 1988. (In Portuguese). (CONF-8810366–: 2. Iberian-American congress of oncology, Salvador, Brazil, 9-14 Oct 1988). In *Proceedings of the 2. Iberian-American Congress of Oncology.* Order Number DE89613927/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

RADIOTHERAPY/biological radiation effects; RADIOTHERAPY/carcinomas; EPITHELIUM; LOW DOSE IRRADIATION; RADIOTHERAPY; CARCINOMAS; X RADIATION

34679 (INIS-BR–1516, pp. 49) **Unusual complication after radiotherapy in a patient with adenocarcinoma: acute gangrene of scrotum (Fournier's gangrene).** Cuevas, J.; Soler, J.J.; Sales, J.; Amorrortu, J.; Nieto, A.; Navarro, V.; Camps, C. Sociedade Brasileira de Cancerologia, Salvador, BA (Brazil). 1988. (In Spanish). (CONF-8810366–: 2. Iberian-American congress of oncology, Salvador, Brazil, 9-14 Oct 1988). In *Proceedings of the 2. Iberian-American Congress of Oncology.* Order Number DE89613927/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

CARCINOMAS/radiotherapy; CARCINOMAS/rectum; RADIATION HAZARDS/gangrene; RADIATION HAZARDS/local irradiation; BIOLOGICAL RADIATION EFFECTS; CARCINOMAS; RADIOTHERAPY; RECTUM; GANGRENE; TESTES

34680 (INIS-BR–1516, pp. 149) **Study of influence of debt of irradiation dose on radiopneumonitis incidence (Thoraric irradiation).** Raposo, J.A.S.; Patricio, M.B.; Jorge, L.; Pereira, M.E.; Soares, J. Sociedade Brasileira de Cancerologia, Salvador, BA (Brazil). 1988. (In Portuguese). (CONF-8810366–: 2. Iberian-American congress of oncology, Salvador, Brazil, 9-14 Oct 1988). In *Proceedings of the 2. Iberian-American Congress of Oncology.* Order Number DE89613927/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

RADIATION INJURIES/dose-response relationships; RADIATION INJURIES/mice; CHEST; COBALT 60; COMPARATIVE EVALUATIONS; MICE

34681 (INIS-BR–1516, pp. 146) **Complications of cancer treatment.** Viamonte Junior, M. Sociedade Brasileira de Cancerologia, Salvador, BA (Brazil). 1988. (In Portuguese). (CONF-8810366–: 2. Iberian-American congress of oncology, Salvador, Brazil, 9-14 Oct 1988). In *Proceedings of the 2. Iberian-American Congress of Oncology.* Order Number DE89613927/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

NEOPLASMS/biological radiation effects; NEOPLASMS/radiotherapy; CHEMOTHERAPY; NEOPLASMS; RADIOTHERAPY; RADIATION HAZARDS

34682 (INIS-mf–11406, pp. 1) **Radiotherapy of the RIH-tumor.** Beck-Bornholdt, H.P. (Hamburg Univ. (Germany, F.R.). Inst.

fuer Biophysik und Strahlenbiologie); Becker, S.; Kleineidam, M.; Maurer, T.; Vogler, H.; Wuurschmidt, F.; Jung, H. European Society for Radiation Biology, Liege (Belgium). 1988. (CONF-8810353–: 21. annual meeting of the European Society for Radiation Biology, Tel-Aviv, Israel, 24-30 Oct 1988). In *European Society for Radiation Biology 21. annual meeting. Program and abstracts.* Order Number DE89613927/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

RHABDOMYOSARCOMAS/fractionated irradiation; RHABDOMYOSARCOMAS/radiotherapy; DOSE-RESPONSE RELATIONSHIPS; RATS; RHABDOMYOSARCOMAS; RADIOTHERAPY; X RADIATION

34683 (INIS-mf–11960) **Radiobiological examinations in ova of Carausius morosus (Indian stick insect) following exposurre to HZE-particles of technical origin. Results of radiation experiments performed by UNILAC (GSI, Darmstadt) and BEVALAC (Lawrence Laboratory, Berkeley, Cal./USA).** Hoeffken, H. Marburg Univ. (Germany, F.R.). Fachbereich Humanmedizin. 29 Mar 1985. 124p. (In German). Order Number DE89783070/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

Preliminary tests were carried out to determine the radiation sensitivity of embryos in the ovum, being exposed to 200 keV X-radiation as well as 12 MeV electron radiation. It was found that the sensitivity towards radiation varies with the stage of embryonic development, which takes about 3 months until maturity. The greatest sensitivity was determined for the period between days 22 and 28 of embryonic development. The hatching rates and time required for the embryos to mature were influenced less by the closely circumscribed action of the HZE-particles than by that of the X-rays, the energy of which is distributed over larger areas. In view of these deviating reaction patterns the 'dose' was preferred to be expressed as ions/cm^2. Quite irrespective of this fact, however, repair errors observed following the penetration of HZE-particles mostly led to much more serious malformations than those occurring in response to the influence of X-rays. Even low dosages were seen to be connected with considerable embryonic damage. HZE-particles particularly rich in energy appear to cause microlesions that are initially compensated for by egg membrane mechanisms, thus allowing embryogenesis to proceed undisturbed. As the lesions themselves remain unaltered, however, they have an inevitable effect at the larval stage. It was concluded from these experiments that simple comparisons with low-ion radiation do not provide an adequate basis to describe the biological role of HZE-particles. Thus, there is no global factor to yield useful information in such comparisons.

34684 (INIS-mf–11967) **Distribution of radioactively labelled myobacterium tuberculosis (^{65}Zn, ^{35}S-BCG) after injection into the anterior chamber. Studies in rabbits with and without anterior chamber sensitisation.** Tabillion, M. Kiel Univ. (Germany, F.R.). Medizinische Fakultaet. 20 Feb 1985. 64p. (In German). Order Number DE89783077/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

The rabbit model was used to study the behaviour of antigens in the eye as well as their spread to extraocular regions. Prior to the investigations, a test dose of ^{35}S-labelled and ^{65}Zn-labelled BCG (Bacille Calmette Guerin) had been injected into the anterior chamber of the eyes of sensitised and non-sensitised rabbits. The percentage of BCG escaping from the aqueous humor and iris was mostly not dependent of the test dose given, nor did the rate of its spread show any relation to the occurrence of an antigen-antibody reaction. On the 32nd day p.i., there were still acid-resisting rods in the uvea, which could be proven by histological examination. As shown by the levels of activity in the iris and ciliary body, the bacteria appear to migrate mostly to these organs and, in the second place, to the choroid membrane. The spread of bacteria in previously sensitised rabbits was not different from the observed in non-sensitised animals. Theories claiming that more antigens are formed in sensitised tissue as compared to non-sensitised tissue cannot be confirmed by the findings revealed here. (TRV).

34685 (INIS-mf–11972) **On the organ distribution of several ^{99m}Tc-labelled tetracyclines.** Weinhold, S.E.M. Freie Univ. Berlin (Germany, F.R.). 11 Feb 1983. 108p. (In German). Order Number DE89783060/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

Experiments in rats have pointed to a high stability of ^{99m}Tc-labelled tetracyclines, which are found in vivo in the form of chemically stable chelate complexes. Their biokinetic behaviour in most organs (the lungs) and the blood is predominantly determined by convection processes. In other organs (notably the kidneys and, to a lesser extent, the liver and spleen) their passage can be described in terms of influx and efflux, with accumulation, metabolisation and excretion of the drug administered being the main steps involved. ^{3}H-Labelled tetracyclines are chemically unchanged tetracyclines showing pronounced lipophilia that tend to be taken up and eliminated via influx and efflux processes in the large majority of organs. The highest blood levels were measured for $^{99m}TcO_4$, which is a hydrophilic substance. None of the substances tested appeared to be able to cross the blood-brain barrier. As far as their chemical structure and solubility in water is concerned, ^{99m}Tc-labelled tetracyclines occupy a position intermediate between the two comparative substances and the blood concentrations measured here were only moderately high. As they are accumulated to a considerable degree in the kidneys, the possibility of these substances' use in connection with renal scintiscans does not seem remote. In view of the fact that only one tenth of the dose of pertechnetate would be required for this purpose, radiation exposure could be reduced to a reasonable minimum. (TRV).

34686 (ISH–126) **Chromosome analysis for exposed and presumably exposed persons, 1985-1987.** Romm, H.; Stephan, G. Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene. Mar 1988. 39p. (In German). Available from Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene.

During the time from 1985 to 1987 chromosome analyses were performed for 85 exposed or apresumably exposed persons. The results of the analyses are presented in this report. The investigated blood samples originate primarily from workers employed in industrial and nuclear power facilities (n=44; 51.8%), in institutions of research and education (n=22, 14.1%) and institutions of public health (n=23, 27.1%). In 45 cases (52.9%) there was no indication of radiation exposure, in 12 cases (14.1%) the estimated equivalent whole body dose was below 0.08 Gy and in 16 within the range of 0.08 and 0.20 Gy. The highest dose estimate (>0.30 Gy) was derived from 4 cases of exposure during the radiation accident in Goiania, Brazil, in 1987. Furthermore, the situation of 14 workers is described who accidentially inhaled tritium gas.

34687 (NAC–88-07) **Radiobiological intercomparison: dosimetry aspects.** Yudelev, M.; Jones, D.T.L.; Vynckier, S. Council for Scientific and Industrial Research, Faure (South Africa). National Accelerator Centre. 1987. 10p. Available from the CSIR, National Accelerator Centre, P.O. Box 72, Faure, 7131, South Africa.

A radiobiological intercomparison study was performed on the neutron therapy facility at the National Accelerator Centre (NAC) in conjunction with personnel from the Universite Catholique de Louvain, Belgium. The relative biological effectiveness of the neutron beam with respect to ^{60}Co was determined. The biological criterion was the regeneration of mice intestinal crypts, 3.5 days after total body irradiation with a single dose. A physical dosimetry intercomparison was undertaken at the same time. Both biological and dosimetric intercomparison are an essential prerequisite for the comparison of clinical data. The dosimetry measurements for the radiobiological experiments are presented here.

34688 (OEVS-Mitteilung–1988, pp. 148-152) **New calculation methods for external radiation exposure.** Jacob, P. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Inst. fuer Strahlenschutz); Paretzke, H.G. Oesterreichischer Verband fuer Strahlenschutz (OeVS), Vienna (Austria). Nov 1988. (In German). (CONF-860969–: 4. European congress and 13. regional congress of the International Radiation Protection Association, Salzburg, Austria, 15-19 Sep 1986). In *4. European congress and 13. regional congress of IRPA. 20 years experience in radiation protection - a review and outlook.* Order Number DE89613806/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

Radiation exposure of human organs from chimney exhaust and from gamma radiation above contaminated soils have been calculated by the Monte Carlo method. A relatively simple calculation method is presented where the influence of the earth surface, the energy dependence of the gamma submersion factor and the geometry dependence of the organ conversion factor can be accounted for. 7 refs., 3 figs., 1 tab.

34689 (OEVS-Mitteilung–1988, pp. 263-290) **Hormesis - hypotheses and facts.** Feinendegen, L.E. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Medizin); Muehlensiepen, H. Oesterreichischer Verband fuer Strahlenschutz (OeVS), Vienna (Austria). Nov 1988. (In German). (CONF-860969–: 4. European congress and 13. regional congress of the International Radiation Protection Association, Salzburg, Austria, 15-19 Sep 1986). In *4. European congress and 13. regional congress of IRPA. 20 years experience in radiation protection - a review and outlook.* Order Number DE89613806/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

Whereas in general the property of biologic systems to react to harming stimuli by changing in a way to immunize against later stimuli (hormesis), is well-known, the corresponding mechanism for low-dose ionizing radiation is doubtful. First, a short report is given of a conference on hormesis by ionizing radiation August 1985 in Oakland, Cal.. Second, own experiments on the immediate and delayed reaction of the cellular enzyme thymidine kinase in the marrow of mice after irradiation are presented. This enzyme is important for DNA synthesis. For several hours after a low dose irradiation the enzyme is inhibited and therefore the effect of a later second dose on the enzyme reduced. 10 refs., 9 figs. (qui).

34690 (OEVS-Mitteilung–1988, pp. 296-299) **Influence of time-projection models on estimates of cancer risk from radionuclides.** Schindel, F. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Inst. fuer Strahlenschutz); Henrichs, K.; Paretzke, H.G. Oesterreichischer Verband fuer Strahlenschutz (OeVS), Vienna (Austria). Nov 1988. (In German). (CONF-860969–: 4. European congress and 13. regional congress of the International Radiation Protection Association, Salzburg, Austria, 15-19 Sep 1986). In *4. European congress and 13. regional congress of IRPA. 20 years experience in radiation protection - a review and outlook.* Order Number DE89613806/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

Estimates of cancer risk obtained from epidemological data depend essentially on the time-projection model, i.e. a model where data from a time-limited observation are extrapolated on the whole lifetime risk. In the present contribution this dependence is quantified, with lung cancer as an example. The influence of the age at irradiation and the temporal pattern of radiation exposition are discussed. 1 ref., 5 figs., 2 tabs.

34691 (OEVS-Mitteilung–1988, pp. 304-307) **Radiation-induced thyroid carcinoma: is radioiodine less effective than X-rays?.** Schmitz-Feuerhake, I. (Bremen Univ. (Germany, F.R.)); Carbonell, P. Oesterreichischer Verband fuer Strahlenschutz (OeVS), Vienna (Austria). Nov 1988. (CONF-860969–: 4. European congress and 13. regional congress of the International Radiation Protection Association, Salzburg, Austria, 15-19 Sep 1986). In *4. European congress and 13. regional congress of IRPA. 20 years experience in radiation protection - a review and outlook.* Order Number DE89613806/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

The NCRP report No.80, 1985 states that iodine is at least 3 times less effective than X-rays. Data from about 20 sources are used to question this statement. 20 refs., 3 figs. (qui).

34692 (OEVS-Mitteilung–1988, pp. 320-332) **Small doses - are they really dangerous?.** Wachsmann, F. Oesterreichischer Verband fuer Strahlenschutz (OeVS), Vienna (Austria). Nov 1988. (In German). (CONF-860969–: 4. European congress and 13. regional congress of the International Radiation Protection Association, Salzburg, Austria, 15-19 Sep 1986). In *4. European congress and 13. regional congress of IRPA. 20 years experience in radiation protection - a review and outlook.* Order Number DE89613806/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

Hormesis (benefical effects of low-level irradiation), linear extrapolation down to zero of dose-response relationships and the ALARA principle held by ICRP are the subject of this talk. 10 figs. (qui).

34693 (OEVS-Mitteilung–1988, pp. 343-347) **Comments on the dose-effect curve at low doses of inhaled alpha-emitters.** Hofmann, W. (Salzburg Univ. (Austria). Inst. fuer Allgemeine Biologie, Biochemie und Biophysik); Lettner, H. Oesterreichischer Verband fuer Strahlenschutz (OeVS), Vienna (Austria). Nov 1988. (CONF-860969–: 4. European congress and 13. regional congress of the International Radiation Protection Association, Salzburg, Austria, 15-19 Sep 1986). In *4. European congress and 13. regional congress of IRPA. 20 years experience in radiation protection - a review and outlook.* Order Number DE89613806/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

Lung cancer incidence data on rats inhaling radon progeny and on beagle dogs inhaling $^{239}PuO_2$ particulates have been analysed and compared to human epidemiological data on radon-induced lung cancer risk. Differences in the dose-response curves are discussed in terms of modifications of the initial cellular response by different physical and biological parameters. 3 figs.

34694 (OEVS-Mitteilung–1988, pp. 414-418) **Estimation of lung dose from a fluorimetric determination of natural uranium in the lung tissue.** Beyer, D. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Abt. Sicherheit und Strahlenschutz); Biehl, R. Oesterreichischer Verband fuer Strahlenschutz (OeVS), Vienna (Austria). Nov 1988. (In German). (CONF-860969–: 4. European congress and 13. regional congress of the International Radiation Protection Association, Salzburg, Austria, 15-19 Sep 1986). In *4. European congress and 13. regional congress of IRPA. 20 years experience in radiation protection - a review and outlook.* Order Number DE89613806/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

A uranium miner died from lung cancer. To determine the cause of the cancer a tissue sample from the lung was investigated for uranium by fluorimetry. The uranium content of the whole lung was about 5μg. It is shown that a determination of uranium incorporation and therefore of the lung dose is doubtful when the interval between the intake and the tissue investigation is large, and an accompanying occupational monitoring was not done. This is because of the large variation of biological decay times even of identical uranium deposits in the organs. UO_2 and U_3O_8 have biological decay times in the lung between 50 and 5000 days. Correspondingly, when the uranium depositions are interpreted as rest burden of the occupational exposure, the lung dose varies between 0,02 and 5 Sv. 8 refs., 2 figs.

34695 (OEVS-Mitteilung–1988, pp. 480-487) **Metabolic models for the metabolism of plutonium and related elements.** Taylor, D.M. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Genetik und Toxikologie von Spaltstoffen). Oesterreichischer Verband fuer Strahlenschutz (OeVS), Vienna (Austria). Nov 1988. (CONF-860969–: 4. European congress and 13. regional congress of the International Radiation Protection Association, Salzburg, Austria, 15-19 Sep 1986). In *4. European congress and 13. regional congress of IRPA. 20 years experience in radiation protection - a review and outlook.* Order Number DE89613806/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

This is a discussion of ICRP publication 1986, from a task group on the absorption of plutonium, neptunium and some other actinides from the gastrointestinal tract. A fractional absorption f_1 of 10^{-3} was adopted for all actinides, which is 10 times larger than the value currently recommended by the ICRP. For the first year of life, a value for f_1 of 10^{-2} is proposed. The relative percentage of deposition between the liver and the skeleton is discussed. A half-life of 8 years is suggested by the data. 7 refs. (qui).

34696 (OEVS-Mitteilung–1988, pp. 671-675) **Biochemical alterations as indicators of radiation exposure.** Hofmann, R. (Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene); Butkowskyj-Walkiw, T.; Stamm, A.; Pufal, D.; Spiegelberg, A.; Stanek, J.; Boegl, W.; Willich, N. Oesterreichischer Verband fuer Strahlenschutz (OeVS), Vienna (Austria). Nov 1988. (CONF-860969–: 4. European congress and 13. regional congress

of the International Radiation Protection Association, Salzburg, Austria, 15-19 Sep 1986). In *4. European congress and 13. regional congress of IRPA. 20 years experience in radiation protection - a review and outlook.* Order Number DE89613806/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

Three bioindicators of radiation injury in the 0,5 - 5 Gy range are discussed: enzyme activity of the α-amylase; electrophoretic mobility of erythrocytes; changes of thymidine concentration in serum. The most useful is registration of α-amylase in blood. However, analysis must be performed within three days after exposure and is only reliable when the salivary glands were directly irradiated. 11 refs., 5 figs. (qui).

34697 (OEVS-Mitteilung–1988, pp. 645-649) **Reference levels for the assessment of internal contamination.** Breuer, F. (ENEA, Rome (Italy)); Frittelli, L. Oesterreichischer Verband fuer Strahlenschutz (OeVS), Vienna (Austria). Nov 1988. (CONF-860969–: 4. European congress and 13. regional congress of the International Radiation Protection Association, Salzburg, Austria, 15-19 Sep 1986). In *4. European congress and 13. regional congress of IRPA. 20 years experience in radiation protection - a review and outlook.* Order Number DE89613806/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

Reference levels for retention and excretion are evaluated, for the assessment of internal contamination, taking the monitoring frequency into account, for routine and special monitoring following the intake of a fraction of ICRP annual limits (ALIs) or of a unit activity. Methodologies are also suggested for taking into account the contribution by previous intakes to excretion or retention. 2 tabs.

34698 (OEVS-Mitteilung–1988, pp. 656-660) **Radiation exposure of the small intestine after ingestion of iron radioisotopes.** Werner, E. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Frankfurt am Main (Germany, F.R.). Abt. fuer Biophysikalische Strahlenforschung); Roth, P.; Hansen, C.; Henrichs, K. Oesterreichischer Verband fuer Strahlenschutz (OeVS), Vienna (Austria). Nov 1988. (In German). (CONF-860969–: 4. European congress and 13. regional congress of the International Radiation Protection Association, Salzburg, Austria, 15-19 Sep 1986). In *4. European congress and 13. regional congress of IRPA. 20 years experience in radiation protection - a review and outlook.* Order Number DE89613806/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

Measurement of retention of ^{59}Fe in the small intestine made on 23 healthy persons and calculations of radiation dose for the duodenum, resulted in doses 20 times higher than those calculated from the ICRP model for the gastro-intestinal tract. 5 refs., 2 figs., 2 tabs.

34699 (OEVS-Mitteilung–1988, pp. 708-711) **Serum amylase as a semiquantitative indicator of an exposure to ionizing radiation.** Willich, N. (University of Munich, Clinic for Radiology, Klinikum Grosshadern, Munich (Germany, F.R.)); Matiske, E.; Hofmann, R.; Boegl, W.; Elsasser, U. Oesterreichischer Verband fuer Strahlenschutz (OeVS), Vienna (Austria). Nov 1988. (CONF-860969–: 4. European congress and 13. regional congress of the International Radiation Protection Association, Salzburg, Austria, 15-19 Sep 1986). In *4. European congress and 13. regional congress of IRPA. 20 years experience in radiation protection - a review and outlook.* Order Number DE89613806/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

Quantitative aspects of amylase-activity increase in serum after a single irradiation of the salivary glands in man are considered. The threshold is about 0,4 Gy; in the range 0,4 - 5 Gy the dose can be estimated semi-quantitatively after 24 hours if the salivary glands were irradiated completely and homogeneously. To obtain a (pre-irradiation) reference level the 72-hour value is used. Non-complete and inhomogeneous irradiation of the glands and fractionated irradiation invalidate the dose assessment. It is concluded that at present serum amylase measurement is the only available biochemical indicator of irradiation dose in man. 7 refs., 2 figs. (qui).

34700 (OEVS-Mitteilung–1988, pp. 842-845) **After Chernobyl whole body measurements.** Hochmann, R. (International Atomic Energy Agency, Seibersdorf (Austria). Laboratories); Ouvrard, R. Oesterreichischer Verband fuer Strahlenschutz (OeVS), Vienna (Austria). Nov 1988. (CONF-860969–: 4. European congress and 13. regional congress of the International Radiation Protection Association, Salzburg, Austria, 15-19 Sep 1986). In *4. European congress and 13. regional congress of IRPA. 20 years experience in radiation protection - a review and outlook.* Order Number DE89613806/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

Soon after Chernobyl accident announcement, the Health Physics Group of IAEA Laboratories at Seibersdorf (Austria) was sollicitated for helping in whole body measurements of individuals which could come back from Chernobyl region, from other parts of USSR or from other boundary countries. In addition, the group decided to intensify such mesurements among IAEA staff, in order to have a control of possible internal contamination, and to collect as much as possible data for further dose assessment to be done by other organizations. Four curves are extracted from the data: a best fitting linear regression line, with results obtained after the 15th Jun. This represents the average total activity present in the body (inhalation and ingestion) at the time of measurement; a decay curve of the mean inhalation value obtain from 'inhalation' group, assuming that no further incorporation occured, and using the ICRP retention scheme, with corrected parameters to take into account variability in individual potassium content; a theoretical 'ingestion' curve, obtained by difference of the two first one; an ingestion curve for the 'ingestion' group. Calculations show that average daily intakes obtained from either curve 3 or curve 4 are in good agreement and that a value of 15 Bq/d should be considered as representing the daily intake through the food chain, during the study period. 1 fig., 3 tabs.

34701 (ORNL/FTR–3051) **[Workshop on transfer of radionuclides to livestock, Christ Church College-University of Oxford, United Kingdom, September 5–8, 1988]: Foreign trip report.** Richmond, C.R. Oak Ridge National Lab., TN (USA). 30 Sep 1988. 12p. Sponsored by DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89014753/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The traveler participated in the Workshop on the Transfer of Radionuclides to Livestock which was held at the Christ Church College-University of Oxford, September 5-8, 1988. The traveler was a member of the program committee that was made up of representatives from ten countries. In addition, the traveler presented a key invited paper entitled "Transfer of Radionuclides to Animals — An Historical Perspective of Work Done in the United States." The aim of the workshop was to review current information obtained from both observations and experimental studies on how various parameters can influence the mechanisms of transfer of radionuclides to human food stuffs. These parameters include source and composition of the diet, chemical form of radionuclides, season, agricultural practices, species, strain, and age. The importance and application of countermeasures for reducing the transfer of radionuclides to food stuffs was also considered. The last session of the meeting included summaries and presentations by each session chairman. This was followed by a general discussion by the attendees that was most profitable and stimulating.

34702 (ORNL/FTR–3260) **[ICRP Task Group meeting, Chiba-shi, Japan, May 22–26, 1989]: Foreign trip report.** Eckerman, K.F. Oak Ridge National Lab., TN (USA). 12 Jun 1989. 7p. Sponsored by DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89014724/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The traveler participated in a meeting of the Task Group in Age-Dependent Dose-per-Unit Intake held at the National Institute for Radiological Sciences (NIRS) in Chiba-shi, Japan, on May 22-26, 1989. The Task Group is composed of Committee 2 members of the International Commission on Radiological Protection (ICRP). The traveler is a member of the Task Group as well as a member of Committee 2. The principle objectives of the meeting were to: (1) finalize the report entitled "Age-dependent Doses to Members of the Public from Intake of Radionuclides: Part 1" and (2) review information and data to appear in Part 2.

34703 (SSI–88-18) **Comparison of radiation and chemical risks.** Bengtsson, G. National Inst. of Radiation Protection, Stockholm (Sweden). 14 Sep 1988. 14p. Order Number DE89618006/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Injury to living cells is caused by mechanisms which in many cases are similar for radiation and chemicals. It is thus not surprising that radiation and many chemicals can cause similar biological effects, e.g. cancer, fetal injury and hereditary disease. Both radiation and chemicals are always found in our environment. One agent may strengthen or weaken the effect of another, be it radiation in combination with chemicals or one chemical with another. The implications of such synergistic or antagonistic effects are discussed. Intricate mechanisms help the body to defend itself against threats to health from radiation and chemicals, even against cancer risks. In a strategy for health, it might be worth to exploit actively these defense mechanisms, in parallel with decreasing the exposures. On particular interest are the large exposures from commonly known sources such as smoking, sun tanning and high fat contents of food.

34704 Life shortening in mice exposed to fission neutrons and gamma rays. VIII. Exposures to continuous gamma radiation. Thomson, J.F. (Argonne National Lab., IL (USA)); Grahn, D. *Radiation Research (USA)*, 118(1): 151-160 (Apr 1989).

Data are presented on the mean aftersurvival of male B6CF1 mice exposed for 22 h per day, 5 days per week, to ^{60}Co gamma radiation at dose rates of 1.36 to 12.64 x 10(-3) cGy/min for 23 weeks or 1.36 to 6.32 x 10(-3) cGy/min for 59 weeks. For deaths from all causes, linear dose-response curves were obtained with slopes (days of life lost/cGy) of 0.158 +/- 0.016 and 0.077 +/- 0.002 for 23- and 59-week exposures, respectively. These values were not significantly altered when the analysis was restricted to those mice dying with tumors (92% of the total) or to those presumably dying from tumors (82% of the total). Analysis of mortality rates showed that about 90% of the radiation-specific excess mortality was tumor related. The 59-week exposure series induced only a small increase in the number of days of life lost/cGy/weekly fraction over that induced by 23 weeks of irradiation, 4.53 +/- 0.15 compared to 3.64 +/ - 0.36 days lost/cGy/weekly fraction. This lower than expected value for 59 weeks of exposure may signal the approach to the final linear, additive, injury term postulated from earlier studies at this laboratory with low-dose-rate, daily, duration-of-life ^{60}Co gamma irradiation.

34705 Quiescence in 9L cells and correlation with radiosensitivity and PLD repair. Mendonca, M.S. (Lawrence Berkeley Lab., Berkeley (USA)); Rodriguez, A.; Alpen, E.L. *Radiation Research (USA)*, 117(3): 433-447 (Mar 1989).

The onset of quiescence, changes in X-ray sensitivity, and changes in capacity for potentially lethal damage (PLD) repair of unfed plateau-phase 9L44 cell cultures have been systematically investigated. The quiescent plateau phase in 9L cells was the result of nutrient deprivation and was not a cell contact effect. Eighty-five to 90% of the plateau-phase cells had a G1 DNA content and a growth fraction less than or equal to 0.15. The cell kinetic shifts in the population were temporally correlated with a developing radioresistance, which was characterized by a larger shoulder in the survival curve of the quiescent cells (Dq = 5.71 Gy) versus exponentially growing cells (Dq = 4.48 Gy). When the quiescent plateau-phase cells were refed, an increase in radiosensitivity resulted which approached that of exponentially growing 9L cells. Delayed plating experiments after irradiation of exponentially growing cells, quiescent plateau-phase cells, and synchronized early to mid-G1-phase cells indicated that while significant PLD repair was evident in all three populations, the quiescent 9L cells had a higher PLD repair capacity. Although data for immediate plating indicated that 9L cells may enter quiescence in the relatively radioresistant mid-G1 phase, the enhanced PLD repair capacity of quiescent cells cannot be explained by redistribution into G1 phase. When the unfed quiescent plateau-phase 9L cells were stimulated to reenter the cell cycle by replating into fresh medium, the first G1 was extended by 6 h compared with the G1 of exponentially growing or refed plateau-phase 9L cells.

5603 Chemicals Metabolism and Toxicology

Refer also to citation(s) 33435, 34496

34706 (CONF-881249–4) **Risk assessment and toxicology data bases: Maximizing resources through data evaluation.** Ensminger, J.T.; Lu, Po-Yung; Wassom, J.S. Oak Ridge National Lab., TN (USA). 1988. 20p. Sponsored by DOE Energy Research. DOE Contract AC05-84OR21400. From National Governor's Association meeting: finding the future conference; Washington, D.C., USA; 12-14 Dec 1988. Order Number DE89013011/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The availability and use of reliable data is the key to any successful forecasting effort. The end product of scientific research and development is new data and information. Much of the scientific data being produced daily is stored in computers for subsequent analysis. This situation provides both an invaluable resource and an enormous challenge. With large amounts of government funds being devoted to health and environmental research programs and with maintenance of our living environment at stake, we must make maximum use of the data resulting from these programs to forecast and avert catastrophic effects caused largely by continuing technological developments. Along with the development of large data banks come variations in the levels of accuracy of the data. The data used in predictive studies must be accurate. Therefore, data evaluation should be the basis of predictive scientific efforts. To make the most of data that has already been prepared, attention and resources should be directed toward data evaluation projects similar to the US Environmental Protection Agency's Gene-Tox Program and the National Library of Medicine's Hazardous Substances Data Bank. These and other such data bases are discussed in this paper. Recommendations have been made for the readers use regarding those data and/or information files that provide the best means of accessing the toxicology literature. 14 refs., 1 fig., 4 tabs.

34707 (ORNL/TM–11195) **Chemical characterization and toxicologic evaluation of airborne mixtures: Chemical characterization of colored signal smokes: Final report.** Buchanan, M.V.; Ma, C.Y. Oak Ridge National Lab., TN (USA). Dec 1988. 95p. Sponsored by Department of Defense. DOE Contract AC05-84OR21400. Order Number DE89013731/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

The chemical compositions of four colored smoke mixes, red, violet, green, and yellow, have been characterized to assess possible changes in composition due to the combustion of these materials as smoke grenades. The smoke mixes and combusted products were fractionated using high performance liquid chromatography and then characterized using combined gas chromatography/mass spectroscopy, direct probe mass spectrometry and laser desorption Fourier transform mass spectroscopy. Structures were confirmed using ^{13}C nuclear magnetic resonance and Fourier transform infrared spectroscopy. The red and violet smoke mixes appeared to undergo more extensive chemical transformation than the green and yellow grenades. Two of the components in the combusted violet smoke mix have previously been shown to exhibit bacterial mutagenicity. 12 refs., 34 figs., 12 tabs.

34708 (PB–89-138838/XAB) **Health and Environmental Effects Profile for Phthalic Acids (o-, m-, p-).** Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment. Aug 1986. 92p. (EPA–600/X-86/292). Available from NTIS, PC A05/MF A01.

The Health and Environmental Effects Profile for Phthalic Acids (o-, m-, p-) was prepared to support listings of hazardous constituents of a wide range of waste streams. Quantitative estimates have been presented provided sufficient data are available. p-Phthalic acid was determined to be a systemic toxicant. A Reference Dose (RfD), defined as an estimate (with uncertainty spanning perhaps an order of magnitude) of the daily exposure to the human population (including sensitive subgroups) that is likely to be without appreciable risk of deleterious effect during a lifetime, for p-phthalic acid is 1.4 mg/kg/day for oral exposure. Existing data are insufficient to determine a Reference Dose (RfD) or a carcinogenic potency factor for o- and m-phthalic acid. The Reportable Quantity (RQ) value of 1, 10, 100, 1000 or 5000 pounds is used to determine the quantity of a hazardous substance for which notification is required in the event of a release (as specified by CERCLA) based on chronic toxicity. The RQ value for p-phthalic acid is 1000. Existing data are insufficient to determine an RQ value for o- and m-phthalic acid.

34709 (PB–89-855811/XAB) **Vinyl chloride and polyvinyl chloride: toxicology. January 1978-February 1989 (Citations**

from the Life Sciences Collection data base). Report for January 1978-February 1989. National Technical Information Service, Springfield, VA (USA). Feb 1989. 165p. Available from NTISPC N01/MF N01.

Supersedes PB–88-857057.

This bibliography contains citations concerning the toxicity of vinyl chloride and polyvinyl chloride following short- and long-term exposures. Metabolism, carcinogenicity, and teratogenitic potential of these substances are considered. Methodology to quantitate their presence in atmospheric dust and body tissues are discussed. Occupational hazards are also noted. (This updated bibliography contains 338 citations, 11 of which are new entries to the previous edition.)

34710 (PB–89-856124/XAB) **Toxicity of pesticides. February 1987-February 1989 (Citations from the NTIS data base). Report for February 1987-February 1989.** National Technical Information Service, Springfield, VA (USA). Feb 1989. 157p. Available from NTISPC N01/MF N01.

Supersedes PB–88-860234.

This bibliography contains citations concerning occupational surveys, clinical investigations, and laboratory analyses pertaining to the toxic effects of pesticides. Topics include terrestrial and aquatic ecosystem responses, regulatory aspects, transport and metabolism, and registration standards and procedures. The detection of specific compounds and their effects on selected species are also discussed. (This updated bibliography contains 291 citations, 49 of which are new entries to the previous edition.)

5604 Other Environmental Pollutant Effects

34711 (AD-A–201254/0/XAB) **Effect of radiofrequency radiation on MRNA expression in cultured rodent cells.** Parker, J.E.; Kiel, J.L.; Winters, W.D. Texas Univ., San Antonio, TX (USA). Health Science Center. 1988. 6p. Available from NTIS, PC A02/MF A01.

Pub. in Physiological Chemistry and Physics and Medical NMR, Vol. 20, 129-13 (1988).

Radiofrequency radiation (RFR) has been reported to induce adverse effects in biological systems, such as teratogenic and embryo lethal effects in mammals particularly during exposures producing significant hyperthermia. Other studies have implicated microwave exposure with causing changes in chromosome number and structure, formation of cataracts in humans rabbits and dogs; and promoting malignant tumor formation in rats, as well as increasing tumor production and leukemias. In addition, microwave exposures have been reported to change the structure of purified double-stranded plasmid DNA, causing it to become nicked and increasing the proportion of relaxed to super coiled molecules. In view of these reports of changes at different levels of cellular function and structure of mammalian systems to microwaves, the authors asked themselves if changes at the level of mRNA expression could be detected after microwave exposure of cultured rodent cells. They chose to look at the mRNA expression of certain oncogenes known to show elevated levels during cell replication, at the heat shock proteins known to respond to stresses other than heat, and at the long terminal repeat (LTR) region of mouse mammary tumor virus in four rodent cell lines.

34712 (AD-A–201279/7/XAB) **Noise assessment of the rocket sled test track operation at Jolloman AFB, New Mexico. Final report.** Shaffer, W.J. Air Force Occupational and Environmental Health Lab., Brooks AFB, TX (USA). Oct 1988. 42p. (USAFOEHL–88-140EH0087JNA). Available from NTIS, PC A03/MF A01.

This report presents the results of noise data measurements of the Holloman AFB rocket-sled test-track operations. Impulse and community noise measurements were made to determine the impact of the rocket-sled noise on the surrounding community. A worst case sled run was measured and used to determine that the rocket sled has very little impact on the community for a worst-case rocket-sled run and little or no impact for the majority of the runs. Recommendations were made to limit the number of people exposed to the rocket sled noise and require test-track personnel to wear hearing protection. Sonic-boom measurement equipment should be purchased to document all sonic booms created by the rocket sled.

34713 (AD-A–201388/6/XAB) **Behavioral effects of chronic exposure to 0.5 mW/cm^2 of 2450-MHz microwaves. Interim report for period ending 1987.** DeWitt, J.R.; D'Andrea, J.A.; Emmerson, R.Y.; Gandhi, O.P. Utah Univ., Salt Lake City, UT (USA). 1987. 10p. Available from NTIS, PC A02/MF A01.

Pub. in Bioelectromagnetics, Vol. 8, 149-157(1987).

Adult male, Long-Evans rats were exposed 7 h a day for 90 days to continuous-wave (CW) 2,450-MHz microwaves at an average power density of 0.5 mW/sq cm. Exposures were in a monopole-above-ground radiation chamber with rats in Plexiglas cages. The resulting specific absorption rate (SAR) was 0.14 W/kg (+ or - 0.01 SEM). Additional rats served as sham-exposed and home-caged controls. All were evaluated daily for body mass and food and water intakes. Once each 30 days, throughout baseline and exposure phases of the experiment, rats in the sham- and microwave-exposed groups were tested for their sensitivity to footshock. After 90-days of exposure, the rats were evaluated on an open field, and active avoidance task and an operant task for food reinforcement. Performance of sham- and microwave-irradiated rats were reliably different on only one measure, the lever-pressing task. The general conclusion reached was that exposure to CW 2,450-MHz microwave radiation at 0.5 mW/sq cm was below the threshold for behavioral effects over a wide range of variables, but did have an effect on a time-related operant task, although the direction of the effect was unpredictable.

34714 (AD-A–201482/7/XAB) **1987 CRC (Coordinating Research Council) octane number requirement survey.** Coordinating Research Council, Inc., Atlanta, GA (USA). Aug 1988. 156p. (CRC–561). Available from NTIS, PC A08/MF A01.

In the forty-first annual statistical survey of current model vehicles conducted by the Coordinating Research Council, Inc., test data were obtained on 389 1987 model vehicles, including 300 passenger cars and 89 light-duty trucks and vans. Eighteen laboratories participated in this Survey. Maximum octane number requirements were determined by testing at maximum-throttle conditions, as well as at part-throttle. Requirements are expressed as the (R+M)/2 octane number, Research octane number, and Motor octane number of the reference-fuel producing knock which was recurrent and repeatable at the lowest audible level. The primary analyses used in this report are based upon (R+M)/2 octane number requirements, rather than upon Research octane number requirements as in Survey reports prior to 1985. Estimated octane number requirements for the total vehicles are weighted in proportion to the 1987 vehicle model production and/or sales figures.

57 HEALTH AND SAFETY

Refer also to citation(s) 34424

34715 (DPSTOM–81) **Root cause analysis handbook.** Armstrong, M.E.; Cecil, W.L.; Taylor, K. Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab. Mar 1988. 196p. Sponsored by DOE Defense Programs. DOE Contract AC09-76SR00001. Order Number DE89013806/JAW. Available from NTIS, PC A09/MF A01 - OSTI; GPO Dep.

The root cause analysis system presented in this handbook is designed for use in investigating and categorizing the root causes of incidents in Savannah River non-reactor facilities. Root cause analysis is simply a tool designed to help incident investigators describe what happened during a particular incident, to determine how it happened, and to understand why it happened. Only when investigators are able to determine why a failure occurred will they be able to specify workable preventive measures.

58 GEOSCIENCES

Refer also to citation(s) 33274

5801 Geology and Hydrology

Refer also to citation(s) 34120, 34756, 34758

34716 (DOE/ER/13796–2) **Three-dimensional computer analysis and modelling of remote sensing-structural geologic problems.** Thiessen, R.L.; Eliason, J.R.; Rieken, E.R. Washington State Univ., Pullman, WA (USA). Dept. of Geology. 1989. 5p. Sponsored by DOE Energy Research. DOE Contract FG06-87ER13796. (CONF-890768–2: International geoscience and remote sensing symposium, Vancouver, Canada, 10-14 Jul 1989). Order Number DE89010875/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Fault and fracture plane orientations and locations are vital for energy resource exploration and assessment, site stability evaluations, mineral exploration, earthquake hazard assessment, groundwater modelling, and basic geologic mapping. A package of geologic spatial analysis (GSA) computer programs designed to determine crustal fracture geometries is being generated. Crustal structures are determined from analysis of digital data bases developed from topography, lineaments from satellite imagery and radar data bases, faults and joints observed in the field, earthquake foci, gravity, magnetics, and borehole data. The unique power of the GSA techniques being developed are their three-dimensionality; older techniques looked at orientations of structures or their surface traces, but rarely both. 34 refs., 3 figs.

34717 (DOE/ER/13796–6) **Quantitative three-dimensional structural techniques.** Thiessen, R.L. Washington State Univ., Pullman, WA (USA). 1989. 57p. Sponsored by DOE Energy Research. DOE Contract FG06-87ER13796. (CONF-890784–: Quantitative three-dimensional structural techniques, Washington, D.C., USA, 15-16 Jul 1989). Order Number DE89010879/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

Quantitative three-dimensional structural analysis using computer-based techniques will be presented and demonstrated. These analyses will demonstrate the use of remote sensing, seismic, geophysical, and field data sets to develop three-dimensional digital structural and lithologic models. The course will include both lectures on the digital analysis techniques and demonstrations of the analyses on an interactive workstation. 18 refs.

34718 (GGU-R–134, pp. 5-18) **U-Pb and Rb-Sr age determinations on Caledonian plutonic rocks in the central part of the Scoresby Sund region, East Greenland.** Hansen, B.T. (Institut fuer Mineralogie, Westfaelische Wilhelms-Universitaet, Muenster (DE)); Borchardt, B.; Steiger, R.H.; Henriksen, N. Groenlands Geologiske Undersoegelse, Copenhagen (Denmark). 1987. In *Geochronological studies in central East Greenland.* Order Number DE89766847/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

Five new U-Pb age determinations on zircons and three new or reanalysed Rb-Sr age determinations of some of the late orogenic plutonic bodies from the Gaaseland - Stauning Alper migmatite and granite zone in the Scoresby Sund region, give Caledonian ages between 428 Ma and 352 Ma. Together with previously published age determinations they suggest a main intrusive epoch around 420 Ma with the last intrusive events as late as 390-350 Ma. In addition analytical data for six previously published Rb-Sr ages from the region are reassessed and presented in full. (author) 23 refs.

34719 (GGU-R–134, pp. 19-24) **Archaean U-Pb zircon ages from the Scoresby Sund region, East Greenland.** Hansen. B.T. (Institut fuer Mineralogie, Universitaet Muenster, Muenster (DE)); Borchardt, B.; Higgins, A.K. Groenlands Geologiske Undersoegelse, Copenhagen (Denmark). 1987. In *Geochronological studies in central East Greenland.* Order Number DE89766847/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

U-Pb analyses on zircons are reported for two rock collections from infracrustal complexes within the East Greenland Caledonian fold belt in the Scoresby Sund region. Calculated minimum ages range from 2800 to 2965 Ma, and are the oldest ages obtained in the region using this method. (author) 13 refs.

34720 (GGU-R–134, pp. 25-37) **Isotopic age dating in Liverpool Land, East Greenland.** Tauber Hansen, B. (Institut fuer Mineralogie, Westfaelische Wilhelms-Universitaet, Muenster (DE)); Friderichsen, J.D. Groenlands Geologiske Undersoegelse, Copenhagen (Denmark). 1987. In *Geochronological studies in central East Greenland.* Order Number DE89766847/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

In Liverpool Land in the eastern part of the Scoresby Sund region gneisses and migmatites were intruded by a number of intermediate plutonites and by younger granites. A number of K-Ar, Rb-Sr and U-Pb isotope age determinations indicate that: (1) the gneisses have a pre-Caledonian as well as a Caledonian history, (2) the migmatites were thoroughly reworked during the late part of the Caledonian orogeny, while (3) the plutonic rocks all seem to have been intruded during the Caledonian orogeny. (author) 19 refs.

34721 (GGU-R–134, pp. 39-51) **Rb-Sr and K-Ar Caledonian ages from the Upper Eleonore Bay Group and Cambrian metasediments of the East Greenland Caledonian fold belt.** Bonhomme, M.G. (Centre de sedimentologie et Geochimie de la Surface, CNRS, Inst. Geologie, Univ. L. Pasteur, Strasbourg (FR)); Caby, R. Groenlands Geologiske Undersoegelse, Copenhagen (Denmark). 1987. In *Geochronological studies in central East Greenland.* Order Number DE89766847/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

Fine sediment fractions $< 2\ \mu$ extracted from various formations of Upper Proterozoic and Cambrian age in Canning Land and Segelsaellskapet Fjord in East Greenland are anchimetamorphic to strongly diagenetic. Rb-Sr and K-Ar isotopic analyses indicate that the metamorphic and diagenetic changes correspond to the main Caledonian event at c. 450 Ma while some of the data are consistent with a younger event at nearly 400 Ma, possibly connected to late Caledonian tectonics. The study also shows the peculiar features of the isotopic diagrams often observed in such conditions: parallel isotopic lines, discordant behaviour of the Rb-Sr and K-Ar chronometers, and the necessity of collecting sets of samples from small homogeneous areas. (author) 36 refs.

34722 (INIS-BR–1536) **Geochronological dating in polycyclic rocks: alternative interpretation to data from Serido (RN-PB) Brazil.** McReath, I.; Sa, E.F.J. de. Sociedade Brasileira de Geologia, Recife, PE (Brazil). Nucleo do Nordeste. 1979. 9p. (In Portuguese). (CONF-7911203–: 9. symposium of geology in northeast, Natal, Brazil, Nov 1979). Order Number DE89619120/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Recent studies revealed a polycyclic history of deformation and metamorphism in the Serido, region, with a minimum of three regionally important events (F_{1-3}) the earliest of which is restricted to gneisses interpreted as basement (Caico Group). A relation between these phases and a complex series of granitic rocks is possible, the oldest generations (G_{1-2}) being gneissified. K/Ar ages normally reflect the regional uplift and other events toward the close of the Brasilian orogeny. Some of the older dates in the 700 - 1.400 m.y. range encountered in intrusives and metamophites may be due to parcial overprinting of earlier events. Reference Rb/Sr isochrons for widely dispersed G_3 granites need checking, but give creditable Brasilian ages. Rb/Sr studies of Serido Group metasediments show disequilibrium with a dispersion of points between a reference Brasilian isochron and one at 2.0 b.y. Parcial rejuvenation during the Brasilian orogeny of older rock series seems the best current explanation, although locally metasomatism may have had some influence, while some effect of initial disequilibrium may also be present. Gneisses yield Rb/Sr isochron ages of ca.2.7 and 1.9 b.y. Unpublished diagrams (B.B.B. Neves, written comm.) show a similar dispersion to that encountered for the Serido Group, and this might be explained in a similar fashion. It should be noted, however, that the distinction between high-grade cover, instrusive orthogneisses and basement is difficult, and that in these analyses some of the former gneisses could have been included. The possible existence of some event at ca.1.1 b.y needs verification.

34723 (INIS-BR–1537) **Chronostratigraphic recognition in Ceara northwest region.** Novais, F.R.G.; Kawashita, K.; Brito Neves, B.B. de. Sociedade Brasileira de Geologia, Recife, PE (Brazil). Nucleo do Nordeste. 1979. 18p. (In Portuguese). (CONF-7911203–: 9. symposium of geology in northeast, Natal, Brazil, Nov 1979). Order Number DE89619121/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

This paper reports a geochronological reconaissance through the K-Ar and Rb-Sr methods in a area northeast of the state of Ceara, aiming to suplement and assess the geological mapping 1/250.000.

Migmatitic rocks of the basement showed values within the span of the transamazonian cycle. The volcanic-sedimentary complex (Grupo Martinopole) showed pre-brazilian Rb-Sr conventional ages and isochronic ages compatible to the brazilian cycle. Likewise, regional metamorphism of brazilian age (c.a. 610 m.y.) was recorded for the clastic-carbonatic metassedimentary rocks of the Ubajara Group. Fissural intrusives cuts rocks of the Ubajara Group and yielded ages around 580 m.y. For the molasse-type sequence of the brazilian system (Massape and Pacuja formations), the age of the Cambrian regional metamorphism was adopted, 535±27 m.y., with late events in Ordovician times (Aprazivel Formation). The post tectonic granitic stocks of Meruoca, Mocambo and Serra da Barriga show problems of geochronological grounds, not solved at this stage. The interval between 540-580 m.y. for their emplacement is adopted in the light of the obtained data.

34724 (INIS-BR–1543) **Geology of Pedra Verde region, Ceara, Brazil.** Korpershoek, H.R.; Mendonca, J.A.C. de; Torquato, J.R. Sociedade Brasileira de Geologia, Recife, PE (Brazil). Nucleo do Nordeste. 1979. 15p. (In Portuguese). (CONF-7911203–: 9. symposium of geology in northeast, Natal, Brazil, Nov 1979). Order Number DE89619124/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The upper Proterozoic Mambira Formation ($\geq$ 1.1000 m.y.) consists of > 1000 m of micaschists with subordinate quartzites and limestones, its upper part, the "Pedra Verde Phyllite", is composed of phyelitic slump breccias, with abundance of pyrite. The Mambira formation crops out in the west flank of the tope Anticline, formed by ~ 600 m of quartzites with sillimanite and/or andalusite (Sao Joaquim Formation), underlain by granitoid gneisses, representing the amphibolite facies. The contact between the Sao Joaquim and Mabira Formations appears to be tectonic. The folding and the metamorphism of the latter date from the Brazilian Cycle, which also affected the gneisses, causing homogeneization of the whole-rock K/Ar ages around 500 m.y. After erosion of some 10.000 m of sedimentary re-activation of the faults, which may already have formed during the deposition of the Mambira Formation resulted in the development of the Ubari Graben. The above formations are unconformably overlain by 300-350 m of subhorizontal Shallow-Marine sandstones belonging to the Serra Grande Formation, of upper silurian to lower devonian ages.

34725 (SKB-TR–88-06) **Description of geological data in SKBs database GEOTAB.** Stark, T. Swedish Nuclear Fuel and Waste Management Co., Stockholm (Sweden). 8 Apr 1988. 57p. Order Number DE89617978/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

Measurements for the characterization of geological, geophysical, hydrogeological and hydrochemical condition have been performed since 1977 in specific site investigation as well as for geoscientific projects. The database comprises four main groups of data volumes. These are: geological data, geophysical data, hydrogeological data, and hydrochemical data. In the database, background information from the investigations and results are stored on-line on the VAX 750, while raw data are either stored on-line or on magnetic tapes. This report deals with geological data and describes the dataflow from the measurements at the sites to the result tables in the database. All of the geological investigations were carried out by the Swedish Geological Survey, and since July 1982 by Swedish Geological Co, SGAB. The geological investigations have been divided into three categories, and each category is stored separately in the database. The are: surface factures, core mapping, and chemical analyses. At SGU/SGAB the geological data were stored on-line on-line on a PRIME 750 mini computer, on microcomputer floppy disks or in filed paper protocols. During 1987 the data files were transferred from SGAB to datafiles on the VAX computer. In the report the data flow of each of the three geological information categories are described separately. (L.E.).

5802 Geophysics

34726 (AD-A–201531/1/XAB) **Large-scale, explicit wave simulations on the CRAY-2.** Wojcik, G.L.; Vaughan, D.K.; Barenberg, M.; Mould, J.; Hulit, M.B. Weidlinger Associates, Palo Alto, CA (USA). 1988. 25p. Available from NTIS, PC A03/MF A01.

Pub. in Applied Numerical Mathematics, Vol. 4, 47-70(1988).

Most time-domain, wave problems in geophysics are intractable by classical analysis methods, due principally to non-separability and to a lesser extent material nonlinearity. Therefore, discrete numerical solutions are often necessary for the simulation of realistic models. Applications in 2-D and 3-D geophysical modeling are the subject of this paper, particularly as solved on a CRAY-2 supercomputer. Implementation and performance differences between earlier CRAYs and the CRAY-2 are described, including the discrepancy between scalar fetch and vector processing speeds. Explicit finite element solvers are applied to applications involving 2-D simulation of a seismic refraction experiment across the state of Maine, 3-D simulation of near-source scattering experiments, and both linear and nonlinear axisymmetric source simulation. Results show that the CRAY-2 allows cost-effective 2-D simulations of truly large-scale models, but only begins to be effective in 3-D for models of interest in geophysics. The large memory (256 megawords) is adequate but a speed increase of at least an order of magnitude is necessary for cost-effective 3-D. True multiprocessor capability (rather than 'multi-computer') provides an alternative to raw speed but involves another set of difficulties.

34727 (CONF-890702–1) **Experimentally observed iron redox kinetics in silicic liquids: implications for Fe^{3+}/Fe^{2+} variations in rhyolite lava: implications for Fesup 3+/Fesup 2+ variations in rhyolite lava.** Naney, M.T.; Swanson, S.E. Oak Ridge National Lab., TN (USA). 1989. 3p. Sponsored by DOE Energy Research. DOE Contract AC05-84OR21400. From 28. international geological congress; Washington, DC, US; July 9, 1989. Order Number DE89001521/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Iron redox kinetics in silicate liquids were investigated by melting 100 mg pellets of compacted rhyolite, pantelleritе, pantelleritic trachyte, and andesite rock powders at 1243 and 1343°C in a moderately reducing furnace atmosphere (log fO_2 = −7.83) for periods of 1 to 4320 minutes. The redox state of glasses produced by quenching these liquids was determined by colorimetric analysis of the ferrous iron and total iron content. Redox equilibrium, indicated by the attainment of a constant FeO/FeO_{tot} ratio, was observed for all temperature-composition conditions studied, except for 1243°C experiments with USGS rhyolite standard RGM-1. This is consistent with the low diffusivity of reacting components in high viscosity rhyolite liquids. In the 1243°C experiments with RGM-1, no change in the FeO/FeO_{tot} ratio was observed after 4320 minutes. This implies that redox equilibrium is not maintained in natural rhyolite lavas which erupt as significantly lower temperatures (720–850°C). We conclude that sluggish redox kinetics precludes major changes in the oxidation state of a rhyolite magma during the eruption process. If this is true, then the quenched magma, represented by glassy rhyolites, preserves the pre-eruption redox signature of the magma. 2 refs.

34728 (DOE/ET/44802–T23) **Aeromagnetic map of Nevada: Las Vegas sheet, Map 95.** Saltus, R.W.; Ponce, D.A. Nevada Bureau of Mines and Geology, Reno, NV (USA). 1988. 16p. Sponsored by DOE Defense Programs. DOE Contract AI08-78ET44802. Available from OSTI - USGS Open File Service, Box 25425, Denver Federal Center, Denver, CO 80225 $4.00 (4.00).

A 1:250,000-scale map showing total intensity of the Earth's magnetic field at intervals of 10 to 500 nanoteslas, and a 1:1,000,000-scale merged aeromagnetic map. The topographic base with drainage pattern and cultural information is from the Las Vegas 1° by 2° Quadrangle. (6 refs.)

34729 (EPRI-NP–6154-Vol.1, pp. 1.1-1.14) **Perspectives on soil structure interaction analysis.** Roesset, J.M. Electric Power Research Inst., Palo Alto, CA (USA). Mar 1989. (CONF-871263–Vol.1: EPRI/NRC/TPC workshop on validation of seismic soil-structure interaction analysis techniques using data from Lotung, Taiwan, Palo Alto, California, USA, 9-11 Dec 1987). In *EPRI/NRC/TPC workshop on seismic soil-structure interaction analysis techniques using data from Lotung, Taiwan. Proceedings: Volume 1.* Order Number DE89008767/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The effect of the flexibility of the soil on the seismic response of structures has been a subject of considerable research and controversy in the last twenty years. This effect is important when dealing with very stiff and massive structures or relatively soft soils. It is not surprising therefore that the developments in the area of dynamic soil structure interaction were closely related and benefited greatly from the impetus at one time on the design and construction of nuclear power plants. A number of sophisticated mathematical techniques, elaborate computer codes and simpler engineering approximation have been developed through the years, and continue to be developed today, to solve the problem in a single step, considering the combined soil-structure system, or in three separate steps using substructuring techniques. There has been on the other hand relatively little experimental verification of the accuracy or reasonableness of different analytical techniques. A brief overview of seismic soil structure interaction, the research that has been performed in the past, its accomplishments and inherent problems, the various methodologies available, normal assumptions and their implications, sources of uncertainty and remaining issues are presented.

34730 (EPRI-NP–6154-Vol.1, pp. 10.1-10.154) **Soil-structure interaction analyses of quarter-scale containment model experiment in Lotung, Taiwan.** Electric Power Research Inst., Palo Alto, CA (USA). Mar 1989. (CONF-871263–Vol.1: EPRI/NRC/TPC workshop on validation of seismic soil-structure interaction analysis techniques using data from Lotung, Taiwan, Palo Alto, California, USA, 9-11 Dec 1987). In *EPRI/NRC/TPC workshop on seismic soil-structure interaction analysis techniques using data from Lotung, Taiwan. Proceedings: Volume 1.* Order Number DE89008767/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The analytical models developed for soil-structure interaction (SSI) analyses and the results obtained for the research project entitled, Analysis of Large-Scale Seismic Experiment in Lotung, Taiwan, sponsored by EPRI are presented. The objective of this research program was to evaluate the validities of the current industry SSI analysis methodologies and to quantify the conservatism and sensitivities of the SSI parameters and procedures, by using the forced-vibration test (FVT) data and the recorded actual earthquake response data obtained for the 1/4-scale containment model structure constructed in Lotung, Taiwan. The approach taken to achieve the objective of this research project was to conduct a series of SSI response prediction analyses, following the current industry SSI analysis practice, for both the forced-vibration tests and the earthquake-induced responses of the 1/4-scale containment model structure. The results of these prediction analyses were, then, systematically compared with the measured response data. The validities, conservatisms, and sensitivities of the SSI analysis methodologies and input parameters used in these analyses were finally evaluated and assessed through comparison and correlation of the analytically predicted results with the measured responses. The results of these analyses are presented.

34731 (EPRI-NP–6154-Vol.1, pp. 11.1-11.65) **Soil structure interaction analyses for 1/4-scale containment model using direct (finite element) method of analysis.** Agrawal, P.K. (Sargent and Lundy, Chicago, IL (USA)); Singh, S.; Cevallos-Candau, P.J. Electric Power Research Inst., Palo Alto, CA (USA). Mar 1989. (CONF-871263–Vol.1: EPRI/NRC/TPC workshop on validation of seismic soil-structure interaction analysis techniques using data from Lotung, Taiwan, Palo Alto, California, USA, 9-11 Dec 1987). In *EPRI/NRC/TPC workshop on seismic soil-structure interaction analysis techniques using data from Lotung, Taiwan. Proceedings: Volume 1.* Order Number DE89008767/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

EPRI, in cooperation with the Taiwan Power Company, has constructed two (1/4 and 1/12) scale reinforced concrete containment models in Lotung, Taiwan, to obtain actual earthquake-induced data for evaluating the current soil-structure interaction (SSI) analysis methodologies. The scope of this work was to evaluate the adequacy of the direct method (finite element method) of SSI analysis by comparing the predicted responses to the measured responses of the 1/4-scale containment model and a piping-steam generator model built inside the containment model. There are various methods and computer programs that have been used in the past to perform the direct method of SSI for earthquake loading. However, the most common and recent finite element method is the analysis of a plane-strain, finite element model of soil and structure using computer program FLUSH. Based on this reason, FLUSH program was specified by EPRI for this study. Results of the study are presented.

34732 (EPRI-NP–6154-Vol.1, pp. 12.1-12.53) **Forced vibration and seismic analyses of Lotung Large Scale Experiment using the SASSI code.** Manrique, M.A. (Impell Corp., Walnut Creek, CA (USA)); Dermitzakis, S.N.; Allahabadi, R. Electric Power Research Inst., Palo Alto, CA (USA). Mar 1989. (CONF-871263–Vol.1: EPRI/NRC/TPC workshop on validation of seismic soil-structure interaction analysis techniques using data from Lotung, Taiwan, Palo Alto, California, USA, 9-11 Dec 1987). In *EPRI/NRC/TPC workshop on seismic soil-structure interaction analysis techniques using data from Lotung, Taiwan. Proceedings: Volume 1.* Order Number DE89008767/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Results are presented of the analytical investigation of the Lotung Large-Scale Experiment. The Electric Power Research Institute (EPRI) and the Taiwan Power Company (TPC) have constructed a one-quarter scale concrete containment structure in the seismically active region of Lotung, Taiwan. Extensive instrumentation was installed in the containment structure and on the field, which monitors the response of the soil and the containment to actual local earthquakes. The objective of the work was to correlate recorded data from forced vibration tests and actual earthquakes with results obtained from analytical investigations using state-of-the-art procedures for soil-structure interaction. In particular, soil-structure interaction (SSI) analyses of the soil-containment system are presented for three different input excitations to the containment: (1) forced-vibrations produced by rotating-mass vibration generators installed at the containment roof, (2) the May 20, 1986 Taiwan earthquake and, (3) the November 14, 1986 Taiwan earthquake. The computer program SASSI (System for Analysis of Soil-Structure Interaction) was used in the SSI analyses of the soil-containment system. A decoupled model of these components was developed and analyzed using the computer program SUPERPIPE. The input excitation to this model consists of the response time histories of the anchor points of the steam generator and the piping to the containment structure.

34733 (EPRI-NP–6154-Vol.1, pp. 13.1-13.44) **Analysis of large-scale containment model in Lotung, Taiwan: forced vibration and earthquake response analysis and comparison.** Johnson, J.J. (EQE Inc., San Ramon, CA (USA)); Maslenikov, O.R.; Mraz, M.J.; Udaka, T. Electric Power Research Inst., Palo Alto, CA (USA). Mar 1989. (CONF-871263–Vol.1: EPRI/NRC/TPC workshop on validation of seismic soil-structure interaction analysis techniques using data from Lotung, Taiwan, Palo Alto, California, USA, 9-11 Dec 1987). In *EPRI/NRC/TPC workshop on seismic soil-structure interaction analysis techniques using data from Lotung, Taiwan. Proceedings: Volume 1.* Order Number DE89008767/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The Electric Power Research Institute (EPRI), Palo Alto, CA, in cooperation with the Taiwan Power Co. (Taipower), has constructed two scale (1/4 and 1/12) reinforced concrete containment models in Lotung, Taiwan, a region where earthquakes occur frequently. The EPRI experiment is extensively instrumented in the free-field and in the structure. The goal of EPRI and Taipower is to measure the responses at instrumented locations due to vibration tests and actual earthquakes so that a valuable data base can be established to evaluate soil-structure interaction (SSI) analysis methodologies. The SMART-1 array will yield free-field ground motion data to help assess the effects of local site amplification on ground motion and free-field ground motion assumptions in SSI analyses. The entire process is documented. The elements of the substructure approach to SSI analysis as it pertains to the one-quarter scale structure and components is presented. The definition of the soil profile at low soil strain levels and at strain levels corresponding to the earthquake excitation level is described. The SSI parameters, the structure and

components and their dynamic models are presented. The response prediction and reconciliation for the Forced Vibration Test (FVT) and earthquakes is presented. Finally, observations and conclusions are discussed.

34734 (EPRI-NP–6154-Vol.1, pp. 2.1-2.9) **Prediction of strong ground motion for structural design.** Bolt, B.A. (Univ. of California, Berkeley (USA)). Electric Power Research Inst., Palo Alto, CA (USA). Mar 1989. (CONF-871263–Vol.1: EPRI/NRC/TPC workshop on validation of seismic soil-structure interaction analysis techniques using data from Lotung, Taiwan, Palo Alto, California, USA, 9-11 Dec 1987). In *EPRI/NRC/TPC workshop on seismic soil-structure interaction analysis techniques using data from Lotung, Taiwan. Proceedings: Volume 1.* Order Number DE89008767/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The reliable prediction of ground shaking required detailed interpretation of the recorded ground motions. Methods for predicting strong ground motions as a basis for structural design are discussed under the following topics: use of strong-motion arrays, earthquake engineering applications, theory of wave coherence, the response of large rigid and flexible structures, and computational results for coherence.

34735 (EPRI-NP–6154-Vol.1, pp. 3.1-3.14) **EPRI/TPC large-scale seismic experiment at Lotung, Taiwan.** Tang, H.T.; Tang, Y.K.; Stepp, J.C.; Wall, I.B.; Lin, E.; Cheng, S.C.; Lee, S.K.; Hsiau, H.N. Electric Power Research Inst., Palo Alto, CA (USA). Mar 1989. (CONF-871263–Vol.1: EPRI/NRC/TPC workshop on validation of seismic soil-structure interaction analysis techniques using data from Lotung, Taiwan, Palo Alto, California, USA, 9-11 Dec 1987). In *EPRI/NRC/TPC workshop on seismic soil-structure interaction analysis techniques using data from Lotung, Taiwan. Proceedings: Volume 1.* Order Number DE89008767/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

When seismic waves impinge on an embedded structure, two physical effects occur simultaneously: (1) seismic waves incident on the structure are diffracted and reflected back into the foundation medium, and (2) motion is transmitted to the structure. The first effect, referred to as kinematic interaction, is independent of the inertial properties of the structure. The second is the dynamic response of the coupled structure-foundation system which is governed by the inertial properties of the structure and foundation impedances. These two effects together are normally referred to as soil-structure interaction (SSI). EPRI and the Taiwan Power Company (TPC) jointly sponsored a large-scale SSI experiment in the field (Tang 1987) to obtain actual strong motion earthquakes induced SSI data. This was accomplished by collecting data from two instrumented, scaled down (1/4- and 1/12-scale) reinforced concrete containments sited in Lotung, a high seismic region in Taiwan, where a strong motion seismic array network is located. The objectives of the experiment were: (1) to obtain an earthquake database which can be used to substantiate SSI models and analysis methods; (2) to develop realistic SSI analysis guidelines and procedures based on experimental-analytical correlation; and (3) to quantify nuclear power plant reactor containment and internal component's seismic margin based on earthquake experience data. Results of the studies are presented.

34736 (EPRI-NP–6154-Vol.1, pp. 4.1-4.20) **Summary of soil characterization program for the Lotung large-scale seismic experiment.** Anderson, D.G. (Soil Dynamics Consultant, Bellevue, WA (USA)); Tang, Y.K. Electric Power Research Inst., Palo Alto, CA (USA). Mar 1989. (CONF-871263–Vol.1: EPRI/NRC/TPC workshop on validation of seismic soil-structure interaction analysis techniques using data from Lotung, Taiwan, Palo Alto, California, USA, 9-11 Dec 1987). In *EPRI/NRC/TPC workshop on seismic soil-structure interaction analysis techniques using data from Lotung, Taiwan. Proceedings: Volume 1.* Order Number DE89008767/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The Electric Power Research Institute (EPRI), in cooperation with the Taiwan Power Company (TPC), has constructed two model structures at a site near Lotung, Taiwan, a seismically active region in northeast Taiwan. The models are scaled to be one-quarter and one-twelfth the size of a typical reinforced concrete containment building. Each structure has been instrumented with accelerometers and total stress cells to record structural response during seismic events. Accelerometers have also been located in the free-field to record ground motions at depth as well as the ground surface. Data collected by these instruments will be used to evaluate and, if appropriate, refine procedures for predicting seismic soil-structure interaction. Details describing the design and instrumentation of the two models are discussed. A brief summary is presented of results from the field and laboratory testing programs. References providing detailed information about site conditions are also cited.

34737 (EPRI-NP–6154-Vol.1, pp. 5.1-5.10) **Validation of seismic soil-structure interaction analysis techniques using Lotung experiment data - EPRI program.** Tang, Y.K.; Tang, H.T.; Stepp, J.C. Electric Power Research Inst., Palo Alto, CA (USA). Mar 1989. (CONF-871263–Vol.1: EPRI/NRC/TPC workshop on validation of seismic soil-structure interaction analysis techniques using data from Lotung, Taiwan, Palo Alto, California, USA, 9-11 Dec 1987). In *EPRI/NRC/TPC workshop on seismic soil-structure interaction analysis techniques using data from Lotung, Taiwan. Proceedings: Volume 1.* Order Number DE89008767/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Essentials of the Lotung experiment, including model configuration, instrumentation setup, site soil characterization, and forced vibration tests are described. The objective, approach, and scope of the method validation program sponsored by EPRI are presented. Also described are the selected earthquakes for the analysis program.

34738 (EPRI-NP–6154-Vol.1, pp. 6.1-6.34) **NRC/ANL participation in the Lotung, Taiwan, large-scale soil-structure-interaction experiment - validation of analysis methods.** Kot, C.A. (Argonne National Lab., IL (USA)); Srinivasan, M.G.; Hsieh, B.J.; Costello, J.F. Electric Power Research Inst., Palo Alto, CA (USA). Mar 1989. (CONF-871263–Vol.1: EPRI/NRC/TPC workshop on validation of seismic soil-structure interaction analysis techniques using data from Lotung, Taiwan, Palo Alto, California, USA, 9-11 Dec 1987). In *EPRI/NRC/TPC workshop on seismic soil-structure interaction analysis techniques using data from Lotung, Taiwan. Proceedings: Volume 1.* Order Number DE89008767/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

As part of an overall effort to validate seismic calculational methods, the US Nuclear Regulatory Commission, is participating in a number of international cooperative experimental programs including the Large-Scale Soil-Structure-Interaction (SSI) Experiment conducted in Lotung, Taiwan, by the Electric Power Research Institute (EPRI) and the Taiwan Power Company (Taipower). Argonne National Laboratory (ANL) on behalf of NRC coordinates the EPRI-NRC collaboration in these experiments. The primary objective for both NRC and EPRI in the Large-Scale SSI experiment is the validation/evaluation of SSI analysis methods. In addition, NRC/ANL also sponsored and carried out the vibration testing of the 1/4-scale containment model. The highlights of the NRC/ANL program approach for the validation of SSI methods are presented. This approach differs slightly in its implementation details from the approach taken by EPRI. Also described are the vibration experiments of the 1/4-scale containment and the results of a modal analysis of the test data. Finally, an effort is outlined for determining the dynamic characteristics of the soil-structure system from the earthquakes response data, and preliminary results are discussed.

34739 (EPRI-NP–6154-Vol.1, pp. 7.1-7.10) **Guidelines for round-robin soil-structure interaction analysis working paper preparation.** Electric Power Research Inst., Palo Alto, CA (USA). Mar 1989. (CONF-871263–Vol.1: EPRI/NRC/TPC workshop on validation of seismic soil-structure interaction analysis techniques using data from Lotung, Taiwan, Palo Alto, California, USA, 9-11 Dec 1987). In *EPRI/NRC/TPC workshop on seismic soil-structure interaction analysis techniques using data from Lotung, Taiwan. Proceedings: Volume 1.* Order Number DE89008767/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Each of the thirteen (13) research teams participated in the round-robin SSI method evaluation program was requested to prepare a working paper to summarize the blind prediction results and research findings for presentation and discussion at the Workshop. A total of twelve (12) working papers were submitted. The working papers covered the general description of the method and scope,

model development and description, forced vibration test (FVT) response prediction and result comparison, earthquake response prediction and result comparison, and method assessment and conclusion. In order to ensure the uniformity of the result presentation, a set of unified guidelines was developed. The guidelines established the following: data package with unified reference numbers, identification of analytical models, and specifications for result presentations and comparisons. Details of the guidelines are provided.

34740 (EPRI-NP–6154-Vol.1, pp. 8.1-8.55) **Prediction of the forced vibration and seismic response of the Lotung (Taiwan) large-scale containment model and comparison with observations.** Luco, J.E. (Univ. of California, San Diego, La Jolla (USA)); Wong, H.L. Electric Power Research Inst., Palo Alto, CA (USA). Mar 1989. (CONF-871263–Vol.1: EPRI/NRC/TPC workshop on validation of seismic soil-structure interaction analysis techniques using data from Lotung, Taiwan, Palo Alto, California, USA, 9-11 Dec 1987). In *EPRI/NRC/TPC workshop on seismic soil-structure interaction analysis techniques using data from Lotung, Taiwan. Proceedings: Volume 1.* Order Number DE89008767/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Comparisons of blind predictions and recorded data for the response of a large-scale containment model located in Lotung, Taiwan are presented. The comparisons include shaker induced vibrations as well as seismic response to the May 20, 1986 (M = 6.5) Taiwan earthquake. The predictions were made by use of the CLASSI substructure approach. Three sets of models (A, B and C) were considered. Model A was based on basic geotechnical data while Model B was based on more complete geotechnical and geophysical information. Model C based on knowledge of the forced vibration response data was used to give a third blind estimate of the seismic response. The differences between the vibration test data and the predictions of Model B fall within the error of the recorded response and of the input data.

34741 (EPRI-NP–6154-Vol.1, pp. 9.1-9.43) **Prediction of quarter scale model response using SIM code.** Miller, C.A. (City Univ. of New York, NY (USA)); Costantino, C.J.; Zerva, A. Electric Power Research Inst., Palo Alto, CA (USA). Mar 1989. (CONF-871263–Vol.1: EPRI/NRC/TPC workshop on validation of seismic soil-structure interaction analysis techniques using data from Lotung, Taiwan, Palo Alto, California, USA, 9-11 Dec 1987). In *EPRI/NRC/TPC workshop on seismic soil-structure interaction analysis techniques using data from Lotung, Taiwan. Proceedings: Volume 1.* Order Number DE89008767/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The Electric Power Research Institute (EPRI) and the US Nuclear Regulatory Commission (NRC) supported a research program where a quarter scale model reactor containment structure has been constructed in Lotung, Taiwan. This is a seismically active region and the same local as the strong motion SMART array supported by the National Science Foundation. Two types of experiments have been conducted by NRC/EPRI at the site. First, shaker tests have been conducted on the model. Second, instrumentation placed on the structure and in the free field has been set to be triggered by seismic motions occurring at the site. Predictions, in the blind, have been supported for both types of experiments. Work performed at the City College of New York (CCNY) in making the blind predictions is described.

34742 (EPRI-NP–6154-Vol.2, pp. 14.1-14.47) **Soil-structure interaction correlations of EPRI/TPC field test results with analytical predictions.** Penzien, J.; Jean, W.Y.; Lee, Y.J.; Chen, C.H. Electric Power Research Inst., Palo Alto, CA (USA). Mar 1989. (CONF-871263–Vol.2: EPRI/NRC/TPC workshop on validation of seismic soil-structure interaction analysis techniques using data from Lotung, Taiwan, Palo Alto, California, USA, 9-11 Dec 1987). In *EPRI/NRC/TPC workshop on seismic soil-structure interaction analysis techniques using data from Lotung, Taiwan. Proceedings: Volume 2.* Order Number DE89008767/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Under contract to the Taiwan Power Company (TPC) Eastern International Engineers, Inc. (EIE) has conducted extensive prediction and correlation analyses for the joint EPRI (Electric Power Research Institute)/TPC soil-structure interaction field test project involving the 1/4-scale containment structure, and associated steam generator system, located in Lotung, Taiwan. These analyses were carried out in eight stages. These stages are listed. In each case, the prediction analyses were carried out and reported to TPC prior to receiving the corresponding field test results. All prediction and correlation analyses were carried out using computer program HASSI-4. The results of the prediction analysis are discussed.

34743 (EPRI-NP–6154-Vol.2, pp. 15.1-15.47) **Predictive response computations for vibration tests and earthquake of May 20, 1986 using an axisymmetric finite element formulation based on the complex response method and comparison with measurements - a Swiss contribution.** Berger, E. (Basler and Hofmann, Zurich (Switzerland)); Fierz, H.; Kluge, D. Electric Power Research Inst., Palo Alto, CA (USA). Mar 1989. (CONF-871263–Vol.2: EPRI/NRC/TPC workshop on validation of seismic soil-structure interaction analysis techniques using data from Lotung, Taiwan, Palo Alto, California, USA, 9-11 Dec 1987). In *EPRI/NRC/TPC workshop on seismic soil-structure interaction analysis techniques using data from Lotung, Taiwan. Proceedings: Volume 2.* Order Number DE89008767/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

A research project on the validation of current soil-structure interaction (SSI) methodologies has been under way since the beginning of 1986. Argonne National Laboratory (ANL) is coordinating the project on behalf of the USNRC and issued a Statement of work to participating universities and national laboratories in April 1986. The major findings and results presented form the four phases of this project. The analysis methods and the model sets used in the predictive response computations are described. A comparison of predictions with measurements for the forced vibration tests and for the earthquake of May 20, 1986 is presented. Finally, a section on conclusions is included.

34744 (EPRI-NP–6154-Vol.2, pp. 16.1-16.50) **Lotung SSI analysis using a 3-D harmonic Green's function method.** Electric Power Research Inst., Palo Alto, CA (USA). Mar 1989. (CONF-871263–Vol.2: EPRI/NRC/TPC workshop on validation of seismic soil-structure interaction analysis techniques using data from Lotung, Taiwan, Palo Alto, California, USA, 9-11 Dec 1987). In *EPRI/NRC/TPC workshop on seismic soil-structure interaction analysis techniques using data from Lotung, Taiwan. Proceedings: Volume 2.* Order Number DE89008767/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Under the sponsor of Tokyo Electric Power Company (TEPCO), this analysis work was carried out following the EPRI's approach, which is divided into the 5 phases: Phase I: Construction of mathematical model denoted by Model B on a basis of the given structural and soil data and blind prediction of Model B subject to the forced vibration test (FVT); Phase II: Comparison of Phase I results with measured data and correlation analysis to construct the FVT correlated model denoted by Model C; Phase III: Blind prediction of Models B and C subject to the May 20, 1986 earthquake; Phase IV: Comparison of predicted responses to the May earthquake with measured data and blind prediction of Model C subject to the Nov. 14, 1986 earthquake; and Phase IV': Comparison of predicted responses to the Nov. earthquake with measured data. In each phase, the analysis results were reported to TEPCO and afterward the corresponding field test results were supplied. The entire process is described.

34745 (EPRI-NP–6154-Vol.2, pp. 17.1-17.51) **Soil-structure interaction analysis of quarter scale model using HYBAX code.** Mita, A.; Nakai, S.; Yamazaki, F.; Sato, T.; Ishii, T. Electric Power Research Inst., Palo Alto, CA (USA). Mar 1989. (CONF-871263–Vol.2: EPRI/NRC/TPC workshop on validation of seismic soil-structure interaction analysis techniques using data from Lotung, Taiwan, Palo Alto, California, USA, 9-11 Dec 1987). In *EPRI/NRC/TPC workshop on seismic soil-structure interaction analysis techniques using data from Lotung, Taiwan. Proceedings: Volume 2.* Order Number DE89008767/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The Lotung SSI research project was initiated by the Electric Power Research Institute (EPRI), the US Nuclear Regulatory Commission (NRC) and the Taiwan Power Company (TPC). Research results and findings obtained through the analysis using the computer code HYBAX (Hybrid Approach for Axisymmetric SSI

Problems) are presented. Another analysis method using the computer code AXERA was also employed. The detailed flow charts of the prediction and correlation studies for the forced vibration test (FVT) and the actual earthquake records (May 20, 1986 and November 14, 1986) are shown. A schematic view of the analysis method used is depicted. The analysis matrix of the work is summarized in which only the properties of the upper two layers of the nine-layered soil model and the backfill are depicted since those of the lower seven layers were not changed throughout the analysis. For FVT blind prediction two models, B1 and B2, were constructed based on the soil data packages. These two models are identical except for the properties of the backfill.

34746 (EPRI-NP–6154-Vol.2, pp. 18.1-18.52) **Soil-structure interaction analysis of quarter scale model using AXERA code.** Sato, T.; Nakai, S.; Yamazaki, F.; Mita, A.; Ishi,, T. Electric Power Research Inst., Palo Alto, CA (USA). Mar 1989. (CONF-871263–Vol.2: EPRI/NRC/TPC workshop on validation of seismic soil-structure interaction analysis techniques using data from Lotung, Taiwan, Palo Alto, California, USA, 9-11 Dec 1987). In *EPRI/NRC/TPC workshop on seismic soil-structure interaction analysis techniques using data from Lotung, Taiwan. Proceedings: Volume 2.* Order Number DE89008767/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Lotung SSI research project was initiated by the Electric Power Research Institute (EPRI), the US Nuclear Regulatory Commission (NRC) and the Taiwan Power Company (TPC). Research results and findings obtained through the analysis using the computer code AXERA (Axisymmetric Earthquake Response Analysis) are presented. Another analysis method using the computer code HYBAX was also employed. The detailed flow charts of the prediction and correlation studies for the forced vibration test (FVT) and the actual earthquake records (May 20, 1986 and November 14, 1986) are shown. A schematic view of the analysis method used is depicted. AXERA based on an axisymmetric finite element method can deal with both substructure and direct approaches. In the present study, the direct approach was chosen. AXERA is similar to ALUSH except that AXERA allows an introduction of viscous boundaries (dashpots) on the bottom surfaced. The analysis matrix of the current work is shown in which only the properties of the upper portion of the layered soil model and the backfill are depicted since the lower portion was not changed throughout the analysis. Based on the soil data packages, Model B was constructed for FVT blind prediction. Since the elastic wave velocities of the backfill are not given, they were assumed in the modeling. Through the comparison between the prediction and FVT measurement, Model C was constructed. Models B and C were used for the blind prediction of responses subjected to May 20, 1986 earthquake. In the earthquake response analysis the computer code SHAKE was utilized to obtain the free-field in-ground motion and to construct equivalent linear soil models. Model C' was further constructed through the comparison between the earthquake response prediction and recorded motions. The response prediction for November 14, 1986 earthquake was finally carried out using the model C'. Results of the analyses are presented.

34747 (EPRI-NP–6154-Vol.2, pp. 19.1-19.47) **Soil-structure interaction analyses of EPRI field test - forced vibration test and earthquake response.** Hanada, K. (Central Research Institute of Electric Power Industry (Japan)); Tohma, J.; Iwatate, T. Electric Power Research Inst., Palo Alto, CA (USA). Mar 1989. (CONF-871263–Vol.2: EPRI/NRC/TPC workshop on validation of seismic soil-structure interaction analysis techniques using data from Lotung, Taiwan, Palo Alto, California, USA, 9-11 Dec 1987). In *Proceedings: EPRI/NRC/TPC workshop on seismic soil-structure interaction analysis techniques using data from Lotung, Taiwan. Volume 2.* Order Number DE89008768/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Electric Power Research Institute (EPRI) supported a research program where a 1/4 scale model of a reactor containment structure was constructed at Lotung in Taiwan. EPRI conducted two types of experiments at the site. First, the forced vibration test were carried out on the model. Second, the various typed instruments were placed on the model and in the field to observe the responses during earthquakes. In order to evaluate and validate the methodologies on SSI problem, EPRI sponsored Lotung Project consisting four phases. Central Research Institute of Electric Power Industry (CRIEPI) has participated in the project from phase III to validate the SSI program currently adopted in the simulation of the forced vibration tests and of the structural behaviors during earthquakes. In the framework of the study, a forced vibration test correlation study and a prediction of the structural responses during the designated earthquakes were performed. The prediction analysis based on the data packages without FVT response curves gave a good estimation for the responses of the model structure to FVT. Hence, the model of the structure and soil were not modified for improvement referring to the observed response curves of FVT and the model. The results of the analytical investigation of the Lotung Experiment are presented.

34748 (EPRI-NP–6154-Vol.2, pp. 20.1-20.21) **Ambient motions of quarter scale containment model in Lotung.** Chen, C. (National Taiwan Univ., Taipei); Tsai, I.; Yeh, C.; Cheng, S. Electric Power Research Inst., Palo Alto, CA (USA). Mar 1989. (CONF-871263–Vol.2: EPRI/NRC/TPC workshop on validation of seismic soil-structure interaction analysis techniques using data from Lotung, Taiwan, Palo Alto, California, USA, 9-11 Dec 1987). In *Proceedings: EPRI/NRC/TPC workshop on seismic soil-structure interaction analysis techniques using data from Lotung, Taiwan. Volume 2.* Order Number DE89008768/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

This study investigated the correlations between the results of ambient motion measurement and forced vibration test conducted on the quarter-scale nuclear power plant containment model built in Lotung, Taiwan. It was found that the natural rocking frequency of the containment model can be clearly identified, locating at frequency 3.8 Hz, from both the ambient motion records and forced vibration tests conducted. However, the torsional frequencies identified from these two results are not consistent because the associated amplitudes of vibration are too low to be very reliable. Results of the tests and conclusions are presented.

34749 (EPRI-NP–6154-Vol.2, pp. 21.1-21.26) **3-D soil-structure interaction analysis of Lotung containment model.** Yeh, C. (National Taiwan Univ., Taipei); Lin, T.; Lai, T.; Chen, C.; Cheng, S. Electric Power Research Inst., Palo Alto, CA (USA). Mar 1989. (CONF-871263–Vol.2: EPRI/NRC/TPC workshop on validation of seismic soil-structure interaction analysis techniques using data from Lotung, Taiwan, Palo Alto, California, USA, 9-11 Dec 1987). In *Proceedings: EPRI/NRC/TPC workshop on seismic soil-structure interaction analysis techniques using data from Lotung, Taiwan. Volume 2.* Order Number DE89008768/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

A three-dimensional soil-structure interaction analysis program SSIP3D is presented. It is based on the hybrid modeling approach. The entire soil-structure system was partitioned into a near-field and a far-field using a hemi-spherical interface passing through the soil region very close to the structure. The near-field was modeled by the finite element method while the far-field was represented by an impedance matrix obtained through the application of the Galerkin's method. For the calculations of the basis functions for the far-field impedance matrix, a very effective algorithm is also presented. Finally, the computer program SSIP3D was used to analyze the forced vibrations of the 1/4-scale containment model in Lotung. The analytical results obtained correlate very well with the field test data.

34750 (EPRI-NP–6154-Vol.2, pp. 22.1-22.20) **Variation and propagation of seismic strong motions across the SMART1-LSST array.** Wen, K. (Taiwan Power Co.); Yeh, Y.T.; Huang, W.; Cheng, S.C. Electric Power Research Inst., Palo Alto, CA (USA). Mar 1989. (CONF-871263–Vol.2: EPRI/NRC/TPC workshop on validation of seismic soil-structure interaction analysis techniques using data from Lotung, Taiwan, Palo Alto, California, USA, 9-11 Dec 1987). In *Proceedings: EPRI/NRC/TPC workshop on seismic soil-structure interaction analysis techniques using data from Lotung, Taiwan. Volume 2.* Order Number DE89008768/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The accelerograms, recorded by the SMART1-LSST array of the 20th day of May, 1986 Taiwan earthquake (M_L = 6.5), were filtered in three frequency bands of 0.8-1.2 Hz, 1.2-2.4 Hz and 3.0-4.0 Hz. They show that the variation of peak ground acceleration of lower frequency band in the LSST array area was smaller than that of the higher frequency band. The difference of the recorded peak ground

acceleration of the same component motion can be as much as about 0.10 g within an area with radius of 55 meters. High resolution frequency-wavenumber analysis shows the direction of the wave approaching the array from the subsurface ranges from 10° to 16°. That is nearly normal incident. The dimension of the area in which the 1/4-scale containment model affects the ground motion is about 10 to 16 meters away from the center of the model. This was examined by analyzing the response spectra and cross-correlation coefficients of the recordings. The power spectra of the downhole and surface motions were also compared and shows that the frequency bands in which the ground motion has been amplified by the soil layers are 0.5-2.0 Hz for EW component and 0.5-2.0 Hz and 2.5-3.0 Hz for NS component. The frequency of peak amplification estimated by Haskell's method (1960) fit the observations quite well.

34751 (EPRI-NP–6154-Vol.2, pp. 23.1-23.27) **Wavetype identification and interpretation of the seismic data in SMART-1 array.** Wang, C.Y. (Taiwan Power Co.); Yeh, Y.T.; Cheng, S.C. Electric Power Research Inst., Palo Alto, CA (USA). Mar 1989. (CONF-871263–Vol.2: EPRI/NRC/TPC workshop on validation of seismic soil-structure interaction analysis techniques using data from Lotung, Taiwan, Palo Alto, California, USA, 9-11 Dec 1987). In *Proceedings: EPRI/NRC/TPC workshop on seismic soil-structure interaction analysis techniques using data from Lotung, Taiwan. Volume 2.* Order Number DE89008768/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The seismic records of SMART-1 array were examined to study the types of waves traveling across the array. It is easy to identify the waveform variation by viewing all seismograms of the array in one seismic section. The complex trace analysis which measures the particle motion at each receiver site gives a convenient way to recognize the wavetype changes. The long wavetrain of 11/14 event is no doubt caused by the trapping of waves within the basin beneath the array. Taking this into consideration, a p-tau analysis of the deconvolved traces was performed in order to retrieve the dispersion properties pertaining to the upper shallow structure. A stochastic inversion incorporating with the surface wave theory was followed to invert the shear wave velocity structure. Low shear wave velocities were found for the upper 3 km. By adding the deeper structure from other studies, a crustal velocity model for the Lanyang area is proposed. The synthetic seismograms of this model have an interesting focusing phenomenon. The traveling time and waveform of theoretical waves agree surprisingly well with those of the observed data.

34752 (EPRI-NP–6154-Vol.2, pp. 24.1-24.42) **Dynamic characteristics of the measured seismic and structural responses data of Lotung 1/4-scale nuclear power plant containment model.** Cheng, S. (Taiwan Power Co., Taipei); Chen, Y.; Hsiau, H. Electric Power Research Inst., Palo Alto, CA (USA). Mar 1989. (CONF-871263–Vol.2: EPRI/NRC/TPC workshop on validation of seismic soil-structure interaction analysis techniques using data from Lotung, Taiwan, Palo Alto, California, USA, 9-11 Dec 1987). In *Proceedings: EPRI/NRC/TPC workshop on seismic soil-structure interaction analysis techniques using data from Lotung, Taiwan. Volume 2.* Order Number DE89008768/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The purpose of this study was to evaluate the variation of the maximum responses of Lotung 1/4 scale containment model due to soil-structure interaction by systematic comparisons of the maximum responses at various locations, and to identify the predominant frequency adopting the power spectrum density and transfer function techniques. The recorded seismic and the containment model response data on May 20, July 30, and November 14, 1986 were used for this study. The following characteristics were obtained as results of the evaluation: (1) the characteristics of the maximum acceleration developed along the scaled model; (2) the characteristics of the maximum acceleration developed along the ground surface and the depth of the underground; (3) the dynamic characteristics of structural responses in relation to soil-structure interaction effect; and (4) the dynamic characteristics of soil responses in relation to soil-structure interaction effect.

34753 (EPRI-NP–6154-Vol.2, pp. 25.1-25.20) **Pore water pressure response measurements at Lotung site.** Shen, C.K. (Univ. of California (USA)); Chan, C.K.; Li, X.S.; Yang, H.W.; Ueng, T.S.; Wu, W.T.; Chen, C.H. Electric Power Research Inst., Palo Alto, CA (USA). Mar 1989. (CONF-871263–Vol.2: EPRI/NRC/TPC workshop on validation of seismic soil-structure interaction analysis techniques using data from Lotung, Taiwan, Palo Alto, California, USA, 9-11 Dec 1987). In *Proceedings: EPRI/NRC/TPC workshop on seismic soil-structure interaction analysis techniques using data from Lotung, Taiwan. Volume 2.* Order Number DE89008768/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

It has been observed many times in the field that ground movement in the form of settlement and/or flow can take place during an earthquake. For a saturated granular soil deposit of relatively low permeability, ground movement due to earthquake motion is often preceded by the buildup of excess pore water pressure in the soil. The amount of pore water pressure buildup thus has a direct bearing on the dynamic response of the soil. Since the behavior of soil is known to be strain and confinement dependent, it is essential that in analyzing the seismic response of a significant structure, such as the containment structure for a nuclear reactor, the non-linear response of the underlying soil layers should be considered. The Lotung model study site, with its extensive ground motion and structure response instrumentation and the deep soil deposits, presents an ideal and rare opportunity to study the pore pressure response and its effect on ground motion as well as soil-structure interaction during earthquake. The scope of the study is discussed. Since the summer of 1985, 4 tasks have been completed. Since the beginning of 1986, a number of significant earthquakes were felt at the Lotung site. Sixteen records from two major earthquakes have been obtained. The design of the pore water pressure sensors, the development of a data acquisition system, and finally a general discussion of the measured pore pressure response records are presented.

34754 (NUREG/CR–5257) **Further neotectonic studies of earthquake zones in the eastern United States.** Talwani, P.; Colquhoun, D.J.; Acree, S.D.; Muthanna, A. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering; South Carolina Univ., Columbia, SC (USA). Dept. of Geological Sciences. Jun 1989. 110p. Sponsored by Nuclear Regulatory Commission. Available from NTIS, PC A06/MF A01 - GPO - OSTI.

Shallow stratigraphic investigations based on borings and relative travel time residuals of teleseismic events were used to investigate geotectonic activity and its relationship to seismicity in South Carolina. Data from 103 wells resulted in a structural contour map of unconformity 8 in the Coastal Plain. Comparisons of the structural contours with magnetic and gravity maps and with epicenters in the Bowman and Charleston-Summerville areas showed that the regional northeast trend is interrupted by northwest trending features in the two seismic areas. The intersection of the northwest and northeast trends appears to be related to the recent seismicity, and basement tectonic activity seems to have influenced the structure of the overlying sediments. Travel times from 180 teleseismic events were normalized to a reference station and corrected for delays in the Coastal Plain sediments. Analysis of the residuals shows a systematic decrease in residuals with distance from the coast. Azimuthal variations at individual stations can be correlated with basement lithology as indicated by gravity and magnetic data. The postulated Ashley River fault coincides with a change in basement velocity structure. The travel time residuals, therefore, confirm the presence of this subsurface fault. 21 refs., 5 figs.

34755 (TAU–8805-2) **Determining geotechnical and hydrogeological parameters using downhole geophysics in the Canadian plains. Phase 2 report. Correlations of existing data.** TransAlta Utilities Corp., Calgary, AB (Canada). 1988. 247p. (MICROLOG–89-01733). Available from Canada Centre for Mineral and Energy Technology, Technical Information Division, 555 Booth St., Rm. 342, Ottawa, ON, Canada K1A 0G1; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

One objective of this work was to evaluate, through correlation, whether various geotechnical and hydrogeological parameters in both coal and oil sands mining operations could be obtained from downhole geophysics. Another objective was to review which tools, not currently in use in Alberta, might have potential to provide the desired parameters. The project used existing data that were

collected with normal industry practices to develop site-specific empirical correlations. The project has demonstrated that trends are present and correlations can be made, but the variance of data scatter makes the direct use of the correlations questionable without further study. At one coal mining operation, the geophysical logs that give the best correlations with geotechnical data are the neutron, density, and sonic logs. The data also show that good correlation was obtained between unconfined compressive strength and sonic transit time. At one oil sands mining operation, the geophysical logs that provided trends were the density and gamma logs when paired with different geotechnical parameters. All of the correlations have a wide scatter of data and could probably be improved by closer examination of the data. Based on this study, it appears that the hydraulic conductivity cannot be estimated from geophysical parameters. A specifically designed program is recommended to obtain detailed geotechnical, geophysical, and hydrogeologic data from a series of carefully cored and logged holes. Major problems were encountered in selecting and sorting of data; existing databases could not be easily related, and these problems are discussed in the report. 8 refs., 92 figs., 12 tabs.

5803 Mineralogy, Petrology, and Rock Mechanics

Refer also to citation(s) 34724

34756 (INIS-BR–1538) **Isotopic data revaluation from Cabo province, with base in Cabo granite petrographic studies.** Legrand, J.M.; Figueiredo Filho, O.A. Sociedade Brasileira de Geologia, Recife, PE (Brazil). Nucleo do Nordeste. 1979. 7p. (In Portuguese). (CONF-7911203–: 9. symposium of geology in northeast, Natal, Brazil, Nov 1979). Order Number DE89619122/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

The Sto Agostinho's Cape granite (NE-Brazil) is formed by two successive instrusions: the first riolitic or migmatitic, replaced by the alkali granite. This process is indicated by the potassic feldspar phenocrystals porpliroblastic assimilation of the riolites, conglobating the re-cristalized matrix minerals. This two times formation is confirmed by geochronological studies in magmatic province. The diagram of the different rocks with alkaline differentiation is distributed in two isochrons. The first isochron age of 135 m.y $\pm$ 0,7 (λ=1,42x10^{-11}) with a Ri = 0,7023, the second determine to the Cape granite 104 m.y $\pm$ 0,7 (λ=1,42x10^{-11}) with a Ri=0,7058. The first pulsation value of 0,7023, indicate a crust origin to the granite. The more elevated value in the second magmatic dike can be explain by the mixture of more or less 99% of crust magma and 1% of plutonic rocks. (C.D.G.).

34757 (LA-UR–89-1791) **Volatilization and mixing in glasses of some Apollo 14 regolith breccias.** Vaniman, D.T.; Heiken, G.H. Los Alamos National Lab., NM (USA). 1989. 20p. DOE Contract W-7405-ENG-36. (CONF-8903111–2: Lunar planetary science conference, Houston, Texas, USA, 12-18 Mar 1989). Order Number DE89013456/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Three unique samples can be distinguished by analysis of all glass types, including devitrified glasses, in a suite of 26 Apollo 14 regolith breccias. These unique samples include the well-studied sample 14315, which has an abundance of anorthositic gabbro glasses and devitrified glasses; 14004,77, which has no glasses other than those that match the local soil; and 14076,5, which contains no glasses similar to the local soil or to LKFM. Sample 14076,5 is clearly exotic, for it contains devitrified glasses of anorthositic composition and of a silica-volatilized (HASP) trend that stems from anorthosite; these silica-volatilized glasses contain the new mineral yoshiokite. HASP glasses in this exotic sample and HASP glass spheres that stem from the Apollo 14 soil composition differ greatly from the HASP glasses at Apollo 16. The various HASP glasses can be just as useful as non-volatilized glasses in searching or major crustal or regolith lithologies. 18 refs., 2 figs., 2 tabs.

34758 (LBL–24914) **FMG, RENUM, LINEL, ELLFMG, ELLP, and DIMES: Chain of programs for calculating and analyzing fluid flow through two-dimensional fracture networks – theory and design.** Billaux, D.; Bodea, S.; Long, J. Lawrence Berkeley Lab., CA (USA). Feb 1988. 78p. Sponsored by DOE Radioactive Waste Management. DOE Contract AC03-76SF00098. Order Number DE89013409/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

This report describes some of the programs developed at Lawrence Berkeley Laboratory for network modelling. By themselves, these programs form a complete chain for the study of the equivalent permeability of two-dimensional fracture networks. FMG generates the fractures considered as line discontinuities, with any desired distribution of aperture, length, and orientation. The locations of these fractures on a plane can be either specified or generated randomly. The intersections of these fractures with each other, and with the boundaries of a specified flow region, are determined, and a finite element line network is output. RENUM is a line network optimizer. Nodes very close to each other are merged, deadends are removed, and the nodes are then renumbered in order to minimize the bandwidth of the corresponding linear system of equations. LINEL computes the steady state flux through a mesh of line elements previously processed by program RENUM. Equivalent directional permeabilities are output. ELLFMG determines the three components of the permeability tensor which best fits the directional permeabilities output by LINEL. A measure of the goodness fit is also computed. Two plotting programs, DIMES and ELLP, help visualize the outputs of these programs. DIMES plots the line network at various stages of the process. ELLP plots the equivalent permeability results. 14 refs., 25 figs.

5804 Geochemistry

34759 (INIS-BR–1545) **Delimitation of potential mineralized zones by regional geochemical prospecting - Brazilian semi-arid northeastern.** Lins, C.A.C. Sociedade Brasileira de Geologia, Recife, PE (Brazil). Nucleo do Nordeste. 1979. 14p. (In Portuguese). (CONF-7911203–: 9. symposium of geology in northeast, Natal, Brazil, Nov 1979). Order Number DE89619694/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Comprised an area bout 124.000 Km^2, a regional geochemical survey was executed with the colection of 2174 stream-sediment samples and 1225 pan-concentrate samples. The stream sediment samples were analysed by emission spectrography for 30 elements (CPRM pattern) and the pan-concentrate by heavy-minerals identification. The main results obtained were the definition of 8 anomalous zones, potencially mineralized in some ore deposits: I - Rio Jacurutu (Sn, Mo, W, Nb, Be), defined by some estaniferous granitic bodies; II - Serra do Gaviao - Serra do Ceu (Cu, Zn, Bi, V, Ni, Nb, La) - comprising the Itatira uraniferous ore deposits (NUCLEBRAS); III - Ceara Alkaline Province (Sr, Ba); IV - Solonopole-Mineirolandia (W,Sn,Be); V - Catole do Rocha (W,Mo,Nb,Sn,Ba, Pb, Cu); VI - Varzea Alegre (Pb,Au); Vii - Pedra Branca-Iapi (Cr,Ni,Co); and VIII - Inhamuns (W,Cu,Bi). Besides these results were obtained some important designs about the distribution and mobility of the trace-elements in this geochemical landscape characterized by a semiarid climate (Bshw - Koppen). The prodominance of clastic dispersion over hidromorphic dispersion causes modification in the homogeneity and consequently the anomaly tail is longer than the one normally expected.

34760 (INIS-BR–1546) **Geochemical orientation in drainage in northestern Scheelitiferous province, Brazil.** Lins, C.A.C.; Wanderley, A.A. Sociedade Brasileira de Geologia, Recife, PE (Brazil). Nucleo do Nordeste. 1979. 32p. (In Portuguese). (CONF-7911203–: 9. symposium of geology in northeast, Natal, Brazil, Nov 1979). Order Number DE89619695/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The sampling model adopted in this work consists in a plottage of 150 collection point, where two samples were taken (pan concentrate and stream sediment samples). In the stream sediment sample two granulometries were separated (minor 80 mesh and miro 40 mesh). Some samples were collected in profile begining at the Bodo and Cafuca Mines and some others collected at random in zones not mineralized. The samples were analysed for W, Cu, Zn, Mo, As, Sb, F, P, Au, and 30 trace-elements (pattern). In the pan concentrate samples the heavy-mineral fraction were identified too. The main conclusions obtained by this work were: in this area clastic dispersion predominates; the best means to be sampled for detection of mineralized skarn is the pan concentrate; the optimum

density for a regional search is 1/30 Km^2; the principal pathfinder elements for scheelite are Mo, F, and Cu; the principal geochemical landscape factor in the area is the relief; a regional geochemical survey through stream sediment and pan concentrate sampling is factible to detect scheelite ores and associated mineralizations. It was recommended to a geochemical regional survey, the following criteria: sampling density 1/30 Km^2; collection of 1 pan concentrate sample and 1 stream sediment sampe both in the same point; to thicken the sampling in areas of uneven refief; in the pan concentrate samples must be analysed W, Au, and 30 trace-elements (pattern) and the stream sediment samples must be analysed for W, F, Cu, Zn and 30 trace-elements (pattern).

34761 (LA-UR–89-645) **Lithologic controls on rock varnish formation as determined by SEM [scanning electron microscope].** Raymond, R. Jr.; Harrington, C.D. Los Alamos National Lab., NM (USA). 1989. 9p. Sponsored by DOE Energy Research. DOE Contract W-7405-ENG-36. (CONF-890748–1: Microbeam Analysis Society meeting, Asheville, North Carolina, USA, 16-21 Jul 1989). Order Number DE89008020/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Rock varnish is a ubiquitous, manganese- and iron-rich coating found on rock exposures in arid and semiarid regions. Recent work has demonstrated the potential for using rock varnish due geomorphic surfaces semi-quantitatively. Such dating relies on ratios of minor elements in the varnish [(Ca + K)/Ti] calculated for a specific geographic area. However, although cation-radio dating has empirically been shown to work, relationships between varnish mineralogies, varnish element contents, varnish diagenesis, and mechanism of vanish formation are not yet understood. In addition, it is not clear what effect these various varnish attributes have on the elemental ratios used in rock vanish dating. We do know, however, that the mineralogy, texture, and morphology of substrate lithologies may greatly affect initial varnish accretion. Understanding this effect may help to clarify uncertainties that now exist in the empirical varnish cation-ratio (VCR) dating technique. 8 figs.

34762 (LA-UR–89-646) **SEM analysis of rock varnish chemistry: A geomorphic age discriminator.** Harrington, C.D.; Raymond, R. Jr. Los Alamos National Lab., NM (USA). Jul 1989. 8p. Sponsored by DOE Energy Research. DOE Contract W-7405-ENG-36. (CONF-890748–2: Microbeam Analysis Society meeting, Asheville, North Carolina, USA, 16-21 Jul 1989). Order Number DE89008019/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Rock varnish, a manganese- and iron-rich coating commonly found on rock surfaces in arid and semiarid regions, has long been of interest as a potential age indicator. Rock varnish has been shown to be an effective medium for dating of geomorphic surfaces over a time range of several thousand to over a million years, utilizing a ratio among minor cations [(K + Ca)/Ti] for the total volume of rock varnish. We have recently, developed a technique using the scanning electron microscope (SEM) equipped with an energy dispersive x-ray analyzer (EDAX) to analyze the chemistry of rock varnish. This technique has several advantages over the earlier cation ratio technique.

5805 Oceanography

Refer also to citation(s) 34491, 34501

64 PHYSICS I

6401 Astrophysics and Cosmology

Refer also to citation(s) 34757, 34945, 34996, 35029

34763 (ACIESP–60(v.3), pp. 185-190) **Gamma-ray observations of supernovae SN1987A.** Souza, C.A.W. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos, SP (Brazil)); Neri, J.A.C.F.; Jayanthi, U.B. Academia de Ciencias do Estado de Sao Paulo, SP (Brazil). 1988. (CONF-8808156–: 6. Japan-Brazil symposium on science and technology, Sao Paulo, Brazil, 10-12 Aug 1988). In *Proceedings of the 6. Japan-Brazil Symposium on Science and Technology.* Order Number DE89612371/JAW. Available from NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS.

SOLID SCINTILLATION DETECTORS/cosmic gamma bursts; SOLID SCINTILLATION DETECTORS/gamma detection; SOLID SCINTILLATION DETECTORS/sensitivity; SUPERNOVAE/cosmic gamma bursts; SUPERNOVAE/energy spectra; BALLOONS; KEV RANGE 100-1000; SENSITIVITY; SUPERNOVAE; TIME-SERIES ANALYSIS

34764 (ACIESP–60(v.3), pp. 199-204) **Intermediate polars observed from Brazil in the last eight years.** Jablonski, F. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos, SP (Brazil)). Academia de Ciencias do Estado de Sao Paulo, SP (Brazil). 1988. (CONF-8808156–: 6. Japan-Brazil symposium on science and technology, Sao Paulo, Brazil, 10-12 Aug 1988). In *Proceedings of the 6. Japan-Brazil Symposium on Science and Technology.* Order Number DE89612371/JAW. Available from NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS.

The results of observations done, in the last eight years, of the Intermidiate Polars (IP): EX Hya, V1223 Sgr, FO Aqr and Ao Psc, are presented. The IP define a subclass of cataclysmic variable stars that present coherent oscillations in their optical and/or X-ray emission. The observations were done from Laboratorio Nacional de Astrofisica, in Itajuba (Brazil). The stability of oscillations in IP was analysed to study the nature of compact stars. (M.C.K.).

34765 (ACIESP–60(v.3), pp. 191-198) **New water masers in the Southern hemisphere.** Scalise Junior, E. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos, SP (Brazil)); Vale, J.L.M. do. Academia de Ciencias do Estado de Sao Paulo, SP (Brazil). 1988. (CONF-8808156–: 6. Japan-Brazil symposium on science and technology, Sao Paulo, Brazil, 10-12 Aug 1988). In *Proceedings of the 6. Japan-Brazil Symposium on Science and Technology.* Order Number DE89612371/JAW. Available from NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS.

A search for water vapor maser have been conducted in the direction of selected strong point sources detected by the Infrared Astronomical Satellite - IRAS. 325 points were observed and 18 water maser sources were detected. The detection rate was 5,6%. The new sources are discussed and compared with the known galactic masers.

34766 (AD-A–201456/1/XAB) **Studies of flares and disappearing magnetic flux. Final report, 1 October 1986-31 March 1988.** Martin, S.F. California Inst. of Tech., Pasadena, CA (USA). Solar Astronomy Group. 31 Mar 1988. 13p. (N–00014-86-K-0139). Available from NTIS, PC A03/MF A01.

Research accomplishments include: (1) Research on 'flaring arches'; (2) A collaborative paper on 'Anomalously Dense Flare Loops' was published; (3) The footprints of the 'giant arches' previously discovered by Z. Svestka were found in hydrogen-alpha observations from the Big Bear Solar Observatory and the Udaipur Solar Observatory; (4) Several sets of new observations showing a relationship between cancelling magnetic fields and flares were acquired and analyzed; and (5) A new hypothesis is advanced that cancelling magnetic fields are necessary condition for the energy build-up to solar flares.

34767 (CBPF-NF–058/88) **Is the number of photons conserved in an expanding universe.** Novello, M.; Oliveira, L.A.R. de; Salim, J.M. Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro, RJ (Brazil). 1988. 35p. Order Number DE89618836/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A Friedman - like scenario in which - due to gravitational interaction - the total number of photons existing in the Universe changes as the Universe expands, is described. The photon number distribution function, in thermal equilibrium, exhibits an explicit dependence on a non-vanishing chemical potential term. This non-null value for the chemical potential of the photon is due to the presence of tidal effects, arising from the direct coupling of the photons - which, in a gravitational field, should not be treated as idealized point-like objects - to the curvature of space-time. As a result, the ratio n_γ/n_B between the numbers of photons and baryons in the Universe is shown to be not a constat, but rather a function of cosmic time, vanishing when the singularity of the standard FRW model is

reached. In consequence, some of the supposed 'fundamental problems' of standard Cosmology (e.g., the explanation of the constancy of the ration n_γ/n_B and thus of the origin fo the total ammount of entropy observed today) are but apparent ones in the present scenario, and may be ipso facto solved.

34768 (CBPF-NF–059/88) **Quantum fields in cosmological space-times: a soluble example.** Costa, I.; Novello, M.; Svaiter, N.F.; Deruelle, N. Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro, RJ (Brazil). 1988. 49p. Order Number DE89618837/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The Klein-Gordon equation for a massive real scalar field in the Novello-Salim Eternal Universe, i.e., non singular spatial homogeneous and isotropic cosmological background which is tangent to Milne universes in the distant past and future (and hence asymptotically flat) and evolves between these two geometries via a phase of contraction to a point of maximum curvature followed by expansion is solved. This allows a computation of the Bogolyubov coefficients of the scalar field, usually interpreted as the rate of creation of matter by the time varying gravitational field, either when the vacuum is defined at the moment of maximum curvature (the false Big-Bang) or at the far beginning of the cosmic evolution. This new exact solution is compared to the results obtained when the geometry is that of the Milne universe.

34769 (CBPF-NF–064/88) **Dissipative effects in Friedmann universes.** Lima, J.A.S. de; Waga, I. Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro, RJ (Brazil). 1988. 27p. Order Number DE89618838/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The relationship between the the different temperatures present in a radiative plasma is examined. In particular, the physical and the operational meanings of Eckart's temperature are discussed. An entropy density formula for the radiative component and its fractional rate are derived. We have also suggested a reformulation of Weinberg's conditions for maximum entropy production. The effect of radiative bulk viscosity in diluting monopoles in the very early universe is estimated.

34770 (DOE/ER/40125–19) **Indiana University High Energy Physics Group, Task C: Technical progress report, December 1, 1988–December 31, 1989.** Bower, C.R.; Heinz, R.M.; Mufson, S.L. Indiana Univ., Bloomington, IN (USA). Dept. of Physics. 1989. 40p. Sponsored by DOE Energy Research. DOE Contract AC02-84ER40125. Order Number DE89013108/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The Indiana University High Energy Physics Group, Task C has been actively involved in the MACRO experiment at Gran Sasso during the current contract year. MACRO is a large US-Italian Monopole, Astrophysics, and Cosmic Ray Observatory being built under the Gran Sasso Mountain outside of Rome. Indiana University is in charge of organizing the United States software effort. We have contributed to the online event display software and the data analysis software. We are also doing development work on the MACRO liquid scintillator. We have set up a Liquid Scintillator Quality Assurance Laboratory in Frascati, Italy. We are producing vertical scintillator tank endplates and calibration boats in our machine shop. We have preliminary data from a test run of one MACRO supermodule. 14 figs.

34771 (ESA-SP–281, pp. 9-16) **Cataclysmic variables.** Cassatella, A. (European Space Agency, Madrid (ES). Villafranca Satellite Tracking Station); Selvelli, P.L. European Space Agency, 75 - Paris (France). Jun 1988. (CONF-8804199–: Celebratory symposium on a decade of UV astronomy with the IUE satellite, Greenbelt, Maryland, USA, 12 Apr 1988). In *Decade of UV astronomy with the IUE satellite. Volume 1 Proceedings of a celebratory symposium.* Order Number DE89012116/JAW. Available from NTIS (US Sales Only), PC A18/MF A01.

Important progress has been made in the last few years in the understanding of the complex phenomena occurring in cataclysmic variables. An outstanding contribution to these advances has been provided by observations with the International Ultraviolet Explorer. The most recent results obtained in the specific cases of classical nove, old novae and recurrent novae are reviewed.

34772 (ESA-SP–281, pp. 17-28) **White dwarfs.** Weidemann, V. (Kiel Univ. (DE). Inst. fuer Theoretische Physik und Sternwarte). European Space Agency, 75 - Paris (France). Jun 1988. (CONF-8804199–: Celebratory symposium on a decade of UV astronomy with the IUE satellite, Greenbelt, Maryland, USA, 12 Apr 1988). In *Decade of UV astronomy with the IUE satellite. Volume 1 Proceedings of a celebratory symposium.* Order Number DE89012116/JAW. Available from NTIS (US Sales Only), PC A18/MF A01.

We exemplify how white dwarf research has profited during the first ten years of IUE. We discuss especially hot DA stars, calibration problems in the SWP range, the 1400/1600 A quasimolecular features in cool spectra, the helium-rich DB and DBA stars, cooler non-DA stars with UV carbon lines of type DQ and metal lines of type DZ. A rediscussion shows that carbon abundances are only weakly dependent on T(eff). For dredge-up this implies helium-layers of different thickness. Finally we mention hot white dwarfs with metal lines, especially the PG 1159 class.

34773 (ESA-SP–281, pp. 41-46) **IUE observations of planetary atmospheres.** Encrenaz, T. (Observatoire de Paris, Section de Meudon, 92 (FR)). European Space Agency, 75 - Paris (France). Jun 1988. (CONF-8804199–: Celebratory symposium on a decade of UV astronomy with the IUE satellite, Greenbelt, Maryland, USA, 12 Apr 1988). In *Decade of UV astronomy with the IUE satellite. Volume 1 Proceedings of a celebratory symposium.* Order Number DE89012116/JAW. Available from NTIS (US Sales Only), PC A18/MF A01.

The UV observation of planetary atmospheres gives access to the upper parts of the atmospheres, below and above the homopause. IUE observations have significantly contributed to our knowledge of the aeronomy and photochemistry of planetary atmospheres. On Venus, SO_2 has been detected; ozone has been observed on Mars; C_2H_2 and NH_3 have been detected in the jovian upper atmosphere; acetylene has been detected also on Saturn and Uranus; aurorae have been detected and mapped on Jupiter and Saturn; the Lyα excess, later interpreted by Voyager as the "electroglow", has been observed on Uranus. The IUE can still be a useful tool for monitoring programs such as ozone on Mars and aurorae on giant planets.

34774 (ESA-SP–281, pp. 193-196) **Observations of galactic WC + O binary systems: HD 97152 and HD 152270.** Auer, L.H. (Los Alamos National Lab., NM (US)); Colome, C.; Koenigsberger, G. European Space Agency, 75 - Paris (France). Jun 1988. (CONF-8804199–: Celebratory symposium on a decade of UV astronomy with the IUE satellite, Greenbelt, Maryland, USA, 12 Apr 1988). In *Decade of UV astronomy with the IUE satellite. Volume 1 Proceedings of a celebratory symposium.* Order Number DE89012116/JAW. Available from NTIS (US Sales Only), PC A18/MF A01.

The IUE observations of the Wolf-Rayet binary systems HD 97152 and HD 152270 are presented. Both systems contain a WC7 component, and both have relatively small orbital inclinations. Weak atmospheric eclipses at emission line wavelengths are detected in HD 97152, the system for which a more suitable phase coverage is available.

34775 (ESA-SP–281, pp. 197-200) **Atmospheric eclipse effects in Wolf-Rayet binaries in the small Magellanic cloud.** Koenigsberger, G. (Universidad Nacional Autonoma de Mexico, Mexico City. Inst. de Astronomia); Moffat, A.F.J.; Auer, L. European Space Agency, 75 - Paris (France). Jun 1988. (CONF-8804199–: Celebratory symposium on a decade of UV astronomy with the IUE satellite, Greenbelt, Maryland, USA, 12 Apr 1988). In *Decade of UV astronomy with the IUE satellite. Volume 1 Proceedings of a celebratory symposium.* Order Number DE89012116/JAW. Available from NTIS (US Sales Only), PC A18/MF A01.

We present the results of IUE observations of three SMC W-R binary systems. Selective atmospheric eclipse effects are evident in HD5980 (WN4+06l:) and Sk 188 (W04+04V), and are very weak, or absent in Sk 108 (WN3+06l). The difference in heavy-metal content between the SMC and Galactic objects is clearly manifest in the lack of atmospheric eclipse effects in the wavelength range $\lambda\lambda$1360-1470 A in HD5980 and Sk 188.

34776 (ESA-SP–281, pp. 209-212) **Matter streams in semi-detached binary systems.** Wonnacott, D. (University Coll., London (UK)). European Space Agency, 75 - Paris (France). Jun 1988.

(CONF-8804199–: Celebratory symposium on a decade of UV astronomy with the IUE satellite, Greenbelt, Maryland, USA, 12 Apr 1988). In *Decade of UV astronomy with the IUE satellite. Volume 1 Proceedings of a celebratory symposium.* Order Number DE89012116/JAW. Available from NTIS (US Sales Only), PC A18/MF A01.

The gas stream between the two components of CX Draconis is observed in the UV and subsequently modelled using a simple ballistic code. To scale the model to the data, an inclination of 15^0 is required. A jet of high velocity material is also present but cannot be accounted for with the aforementioned model. It is conjectured that viscosity will cause the infalling stream to spread to the extent that it can avoid collision with the photosphere of the primary and escape from the system by a gravitational slingshot effect.

34777 (ESA-SP–281, pp. 233-236) **Model chromosphere and transition region for 56 Peg (K0 IIp + wd): A preliminary study.** Munday, M.G. (Oxford UNiv. (UK). Dept. of Theoretical Physics). European Space Agency, 75 - Paris (France). Jun 1988. (CONF-8804199–: Celebratory symposium on a decade of UV astronomy with the IUE satellite, Greenbelt, Maryland, USA, 12 Apr 1988). In *Decade of UV astronomy with the IUE satellite. Volume 1 Proceedings of a celebratory symposium.* Order Number DE89012116/JAW. Available from NTIS (US Sales Only), PC A18/MF A01.

Observations of 56 Peg (K0 IIp + wd) have shown the presence of ultraviolet emission lines associated with warm (10^5 K) material. It has been suggested that this emission comes from an ionized region in a cool wind around the secondary. The characteristics of the emission, however, support the view that the lines are formed in a transition region around the late-type supergiant. A self-consistent model chromosphere and transition region are presented here as further evidence. A satisfactory model, taking into account the transition region material, the variable asymmetry in Mg II and the X-ray emission might be possible in terms if a hybrid supergiant with an X-ray illuminated cool wind.

34778 (ESA-SP–281, pp. 237-240) **Cepheid binaries with large mass ratios (M_1/M_2).** Evans, N.R. (Toronto Univ., Ontario (CA). Dept. of Astronomy). European Space Agency, 75 - Paris (France). Jun 1988. (CONF-8804199–: Celebratory symposium on a decade of UV astronomy with the IUE satellite, Greenbelt, Maryland, USA, 12 Apr 1988). In *Decade of UV astronomy with the IUE satellite. Volume 1 Proceedings of a celebratory symposium.* Order Number DE89012116/JAW. Available from NTIS (US Sales Only), PC A18/MF A01.

Because of the temperature difference between Cepheids and their hot main sequence companions, the properties of both stars can be determined, even for mass ratios (M_1/M_2) larger than 3.0. IUE observations of 3 Cepheid systems (Polaris, FF Aql, and S Sge) are used to derive, or set limits on, the temperatures and masses of the companions. Light from the companions of FF Aql and S Sge from 1700 to 2000 A is consistent with an A5 to A7 main sequence companion for both Cepheids, with a mass of 1.8 solar mass. This mass for the companion of S Sge is smaller than required by the orbital mass function and an evolutionary mass of the Cepheid, suggesting that the companion may itself be a binary. For Polaris, the mass of the companion must be less than 1.8 solar mass.

34779 (ESA-SP–281, pp. 283-286) **On the flux-period and flux-flux correlations in late type stars.** Montesinos, B. (Oxford Univ. (UK). Dept. of Theoretical Physics); Jordan, C. European Space Agency, 75 - Paris (France). Jun 1988. (CONF-8804199–: Celebratory symposium on a decade of UV astronomy with the IUE satellite, Greenbelt, Maryland, USA, 12 Apr 1988). In *Decade of UV astronomy with the IUE satellite. Volume 1 Proceedings of a celebratory symposium.* Order Number DE89012116/JAW. Available from NTIS (US Sales Only), PC A18/MF A01.

The analysis of a wide sample of stars including both main-sequence and evolved stars shows that whilst flux-flux correlations are the same for the whole sample, the flux-period relations show a lower dependence on period for evolved stars. A gravity dependence also enters the flux-period relation for evolved stars. The flux-flux and flux-period relations are combined with coronal parameters to express P_c, T_c and B_c in terms of the period. All increase with decreasing period, as expected if dynamo action controls activity. Some specific relations between observable quantities are found which could be tested from further observations. Exploratory calculations of the convective zone fields in midly evolved stars suggests that a larger convective zone field results which could explain the greater emission from evolved stars for a given period.

34780 (ESA-SP–281, pp. 295-298) **Doppler imaging of a Lacertae at three epochs.** Walter, F.M. (Colorado Univ., Boulder (US)); Neff, J.E.; Linsky, J.L.; Rodono, M. European Space Agency, 75 - Paris (France). Jun 1988. (CONF-8804199–: Celebratory symposium on a decade of UV astronomy with the IUE satellite, Greenbelt, Maryland, USA, 12 Apr 1988). In *Decade of UV astronomy with the IUE satellite. Volume 1 Proceedings of a celebratory symposium.* Order Number DE89012116/JAW. Available from NTIS (US Sales Only), PC A18/MF A01.

Doppler imaging analysis allows use of the information contained in a time sequence of spectral line profiles to deduce the size, location, and surface flux of regions of contrasting brightness on rotating stars. We have used IUE observations to study the structure of the lower chromosphere of AR Lacertae in the light of Mg II k. We have obtained sequences of LWR/P-HI images distributed around the binary period at three epochs. We have identified discrete plage-like regions of enhanced Mg II surface flux in this system. There are temporal variations in the Mg II flux on timescales of hours as well as substantial changes in chromospheric morphology on timescales of years. Even with the limited S/N attainable with the IUE, one can map the gross structures of active stellar atmospheres. With such information, one can begin to study the true 3-D structure of the atmospheres of late-type stars.

34781 (ESA-SP–281, pp. 299-302) **Rotational modulation of hydrogen Lyman alpha flux from 44i Bootis.** Vilhu, 0. (Helsinki Univ. (FI). Observatory and Astrophysics Lab.); Neff, J.E.; Rahunen, T. European Space Agency, 75 - Paris (France). Jun 1988. (CONF-8804199–: Celebratory symposium on a decade of UV astronomy with the IUE satellite, Greenbelt, Maryland, USA, 12 Apr 1988). In *Decade of UV astronomy with the IUE satellite. Volume 1 Proceedings of a celebratory symposium.* Order Number DE89012116/JAW. Available from NTIS (US Sales Only), PC A18/MF A01.

We present IUE observations that cover the entire 6.4 hour orbital cycle of the late-type contact binary 44i Bootis. The intrinsic stellar hydrogen Lyman alpha emission flux was determined from low-resolution IUE spectra, compensating for geocoronal emission and for interstellar absorption. The variation of the stellar Lyman alpha emission flux correlates well with the variation of the CII and CIV emission fluxes, and it shows orbital modulation in phase with the visual light curve. The ratio of Lyman alpha to CII flux (15 to 20) is similar to that observed in solar active regions. Hydrogen Lyman alpha emission is thus one of the most important cooling channels in the outer atmosphere of 44i Boo. We obtained a high-resolution spectrum of the Lyman alpha line between orbital phases 0.0 and 0.6. The integrated flux in the observed high-resolution Lyman alpha profile is consistent with the fluxes determined using low-resolution spectra, and the composite profile indicates that both components of this binary have equally active chromospheres and transition regions. The uncertainty in the interstellar hydrogen column density cannot mimic the observed variation in the integrated Lyman alpha flux, because the stellar line is very much broader than the interstellar absorption.

34782 (ESA-SP–281, pp. 303-306) **Mapping of surface activity on the W UMa-type system VW Cephei.** Guinan, E.F. (Villanova Univ., PA (US). Dept. of Astronomy); Bradstreet, D.H. European Space Agency, 75 - Paris (France). Jun 1988. (CONF-8804199–: Celebratory symposium on a decade of UV astronomy with the IUE satellite, Greenbelt, Maryland, USA, 12 Apr 1988). In *Decade of UV astronomy with the IUE satellite. Volume 1 Proceedings of a celebratory symposium.* Order Number DE89012116/JAW. Available from NTIS (US Sales Only), PC A18/MF A01.

MUltifilter photometry of the W UMa-type contact binary VW Cep (P = 6.67 hr; G5V + K0V) in 1986/87 revealed large asymmetries in the light curves believed to be caused by large, cool starspot regions on the surface of the larger star. In April 1987 we observed VW Cep with IUE to study the chromospheres and transition regions of the components. During one complete orbital cycle 3 SWP and 4 LWP low dispersion spectra were obtained including and then

excluding the suspected active region. For the first time, phase dependent TR line emission strengths were found, most notably CIV, which was 50% stronger when the spot region was most visible. These results could be important because VW Cep represents an extreme case for studying stellar dynamo theory and observations can play a crucial role in the understanding of magnetic fields and activity cycles in rapidly rotating solar-like stars.

34783 (ESA-SP–281, pp. 307-310) **Ultraviolet flares on II Peg.** Doyle, J.G. (Armagh Observatory (IE)); Byrne, P.B. European Space Agency, 75 - Paris (France). Jun 1988. (CONF-8804199–: Celebratory symposium on a decade of UV astronomy with the IUE satellite, Greenbelt, Maryland, USA, 12 Apr 1988). In *Decade of UV astronomy with the IUE satellite. Volume 1 Proceedings of a celebratory symposium.* Order Number DE89012116/JAW. Available from NTIS (US Sales Only), PC A18/MF A01.

IUE observations of the RS CVn star II Peg in the upper chromospheric and transition regions lines MgIIk, CIV and HeII in February 1983 shows evidence for flare activity. The electron pressure derived from the mean of two different line ratios produce good agreement between the allowed and intersystem lines in the differential emission measure curves. The total radiative losses from the chromosphere and transition region for the first flare on Feb. 2 is 2.46 10^{35} erg and at least 1.91 10^{34} erg for the flare on Feb. 4.

34784 (ESA-SP–281, pp. 311-314) **Chromospheric mass motions during a flare on UV Ceti.** Phillips, K.J.H. (Appleton Lab., Chilton (UK)); Bromage, G.E.; Dufton, P.L.; Keenan, F.P.; Kingston, A.E. European Space Agency, 75 - Paris (France). Jun 1988. (CONF-8804199–: Celebratory symposium on a decade of UV astronomy with the IUE satellite, Greenbelt, Maryland, USA, 12 Apr 1988). In *Decade of UV astronomy with the IUE satellite. Volume 1 Proceedings of a celebratory symposium.* Order Number DE89012116/JAW. Available from NTIS (US Sales Only), PC A18/MF A01.

Simultaneous optical and IUE observations of a flare on UV Ceti in 1980 are reported. The IUE spectra show only slight increase of C IV line emission. The optical spectrophotometric observations show, from Balmer line profiles, some turbulent broadening in quiescent and flare spectra, and downward-directed flow (of 100 $km.s^{-1}$) during the flare. The latter is particularly reminiscent of solar flares, and probably arises from the formation of a chromospheric condensation, as modelled for solar flares.

34785 (ESA-SP–281, pp. 319-322) **Transition regions of dM stars.** Byrne, P.B. (Armagh Observatory (IE)); Doyle, J.G. European Space Agency, 75 - Paris (France). Jun 1988. (CONF-8804199–: Celebratory symposium on a decade of UV astronomy with the IUE satellite, Greenbelt, Maryland, USA, 12 Apr 1988). In *Decade of UV astronomy with the IUE satellite. Volume 1 Proceedings of a celebratory symposium.* Order Number DE89012116/JAW. Available from NTIS (US Sales Only), PC A18/MF A01.

We have observed weak upper-chromospheric and transition region (TR) emission from two dM stars (G1784 and G1825) using deep IUE SWP exposures. In addition to the usual TR lines, Lyα fluxes for the two stars were also determined for the first time. In this paper we discuss the relative importance of Lyα and MgII as chromospheric coolants in the M dwarfs and the status of the X-ray/ HeII (1640A) relationship in the light of these results.

34786 (ESA-SP–281, pp. 327-330) **Line formation of cool carbon star chromospheres.** Luttermoser, D.G.; Johnson, H.R.; Avrett, E.H. European Space Agency, 75 - Paris (France). Jun 1988. (CONF-8804199–: Celebratory symposium on a decade of UV astronomy with the IUE satellite, Greenbelt, Maryland, USA, 12 Apr 1988). In *Decade of UV astronomy with the IUE satellite. Volume 1 Proceedings of a celebratory symposium.* Order Number DE89012116/JAW. Available from NTIS (US Sales Only), PC A18/MF A01.

Based on adopted photospheric plus chromospheric models, we generate synthetic fluxes of the C II (UV 0.01) and both fluxes and profiles for the Mg II (UV 1) lines in both complete (CRD) and partial (PRD) redistribution and compare them to IUE spectra of the carbon star TX Psc. Non-LTE calculations with the program, PANDORA are made for H, C, Na, Mg, and Ca. For CRD and a well constrained chromospheric model, the best fit to the Mg II line profiles gives a flux in the C II lines (produced surprisingly, at the same depth as the Mg II lines) 2.6 times too great and produces too much emission in the Mg II line wings. PRD in the Mg II h and k lines in an expanding chromosphere with an adjusted temperature structure produces the observed Mg II emission. The reduction in temperature produces C II fluxes that match the IUE low resolution spectra.

34787 (ESA-SP–281, pp. 339-342) **Discovery of a co-rotating magnetosphere in a helium weak star: HD 5737=α Scl.** Shore, S.N. (New Mexico Inst. of Mining and Technology, Socorro (US). Dept. of Physics); Brown, D.N.; Sonneborn, G. European Space Agency, 75 - Paris (France). Jun 1988. (CONF-8804199–: Celebratory symposium on a decade of UV astronomy with the IUE satellite, Greenbelt, Maryland, USA, 12 Apr 1988). In *Decade of UV astronomy with the IUE satellite. Volume 1 Proceedings of a celebratory symposium.* Order Number DE89012116/JAW. Available from NTIS (US Sales Only), PC A18/MF A01.

Previous work on the sn stars has demonstrated the existence of magnetically controlled mass outflows in several stars. Here we report the discovery, using combined IUE spectroscopy and Zeeman polarimetric magnetic field measurements, of the first bona fide example of a magnetosphere in a helium weak star. HD 5737=α Scl is one of the extreme He weak stars in its He deficiency, but is otherwise quite similar to the other sn stars HD 21699 and HD 79158. We report a unique period for the magnetic and C IV and Si IV variations of 21.65 days, about a factor of 10 longer than the other variable sn stars. The effective (longitudinal) field nulls correspond extremely well to C IV line strength maxima. The magnetic field and equatorial magnetosphere are highly oblique (about 70^0) and the line variations appear to be stable.

34788 (ESA-SP–281, pp. 357-360) **FeII level population in luminous variable stars.** Viotti, R. (Consiglio Nazionale delle Ricerche, Frascati (IT). Lab. di Astrofisica Spaziale); Rossi, C.; Muratorio, G.; Friedjung, M.; Baratta, G.B. European Space Agency, 75 - Paris (France). Jun 1988. (CONF-8804199–: Celebratory symposium on a decade of UV astronomy with the IUE satellite, Greenbelt, Maryland, USA, 12 Apr 1988). In *Decade of UV astronomy with the IUE satellite. Volume 1 Proceedings of a celebratory symposium.* Order Number DE89012116/JAW. Available from NTIS (US Sales Only), PC A18/MF A01.

We have derived the overall FeII level population in the luminous variable stars KQ Pup and AG Car using the Self Absorption Curve method of analysis of the optical and UV FeII emission lines. We found that most levels are nearly populated according a Boltzmann-type law with excitation temperatures of 6500 and 7500 K for KQ Pup and AG Car respectively. For KQ pup there is evidence of selective excitation processes and dielectronic recombination in the level population. The importance of the study of the FeII spectrum as diagnostics of the physical processes in astrophysical objects - from stellar chromospheres to distant galaxies - is finally discussed.

34789 (ESA-SP–281, pp. 365-368) **Periodic modulation of the atmosphere of alpha Orionis.** Dupree, A.K. (Harvard-Smithsonian Center for Astrophysics, Cambridge, MA (US)); Baliunas, S.L.; Hartmann, L.; Nassiopoulos, G.E.; Guinan, E.F.; Sonneborn, G. European Space Agency, 75 - Paris (France). Jun 1988. (CONF-8804199–: Celebratory symposium on a decade of UV astronomy with the IUE satellite, Greenbelt, Maryland, USA, 12 Apr 1988). In *Decade of UV astronomy with the IUE satellite. Volume 1 Proceedings of a celebratory symposium.* Order Number DE89012116/JAW. Available from NTIS (US Sales Only), PC A18/MF A01.

Alpha Orionis (Betelgeuse; M2 Iab) has been monitored with IUE since 1984. Discovery of a 420-day periodic modulation of the flux in the optical and ultraviolet continua, and in the Mg II h and k line emission cores suggested that periodic photospheric pulsations were present from 1984-1986. This behavior continues through 1987. However, the general flux level of the ultraviolet continuum and the Mg II lines is decreasing, and the amplitude of the variation may be reduced. These decreases may be the emerging signature of an additional longer period. The density sensitive C II diagnostic, λ2325.4/λ2328.1, indicates the chromospheric densities range between log N_e (cm^{-3}) = 8.7 and 9.5, but periodicities are not yet evident.

34790 (ESA-SP–281, pp. 308-372) **MG II line profiles of the Mira S Carinae.** Brugel, E.W. (Colorado Univ., Boulder (US). Dept. of Astrophysical Science); Bookbinder, J.A.; Brown, A. European Space Agency, 75 - Paris (France). Jun 1988. (CONF-8804199–: Celebratory symposium on a decade of UV astronomy with the IUE satellite, Greenbelt, Maryland, USA, 12 Apr 1988). In *Decade of UV astronomy with the IUE satellite. Volume 1 Proceedings of a celebratory symposium.* Order Number DE89012116/JAW. Available from NTIS (US Sales Only), PC A18/MF A01.

A series of high-dispersion IUE observations obtained to investigate the evolution of the shock structure of the Mira S Carinae (S Car) have produced - despite very limited phase coverage - a set of five exceptionally interesting spectra of the Mg II h and k lines. The two primary findings of these observations are (1) there is significant emission from both the h and k lines at velocities of -150 $km.s^{-1}$ relative to the stellar photosphere and (2) the h-to-k ratio of the Mg II doublet remains below the theoretically predicated values of 2:1 to 1:1, and shows a smooth dependence on the optical phase. Archival studies of other Miras (e.g. R Car) indicate that S Car is not unique in possessing unusual and highly variable Mg II h and k line profiles.

34791 (ESA-SP–281, pp. 373-376) **Variability of the UV spectrum of the symbiotic star BF Cygni.** Gonzalez-Riestra, R. (European Space Agency, Madrid (ES). Villafranca Satellite Tracking Station); Cassatella, A.; Fernandez-Castro, T. European Space Agency, 75 - Paris (France). Jun 1988. (CONF-8804199–: Celebratory symposium on a decade of UV astronomy with the IUE satellite, Greenbelt, Maryland, USA, 12 Apr 1988). In *Decade of UV astronomy with the IUE satellite. Volume 1 Proceedings of a celebratory symposium.* Order Number DE89012116/JAW. Available from NTIS (US Sales Only), PC A18/MF A01.

In this work we present the preliminary results of our monitoring of the symbiotic star BF Cygni. We have been carrying out regular observations of this system, both in low and high resolution, since July 1986 with the aim of covering a full photometric period. In order to study the long-term UV variability of the system, we have used our spectra together with archive data taken during the period 1979-1981. During the IUE lifetime, BF Cygni has undergone dramatic changes in the UV continuum and emission line fluxes. Most of the emission lines vary in phase with the continuum with deep eclipses near photometric phase 0. All the observational evidences support a model in which the variability of the system could be mainly due to occultations of the different emitting regions during the orbital motion.

34792 (ESA-SP–281, pp. 377-380) **Abundance and f values needed to interpret adequately the high resolution I.U.E. spectra.** Freire Ferrero, R. (Institut d'Astrophysique Spatiale, 91 - Verrieres-le-Buisson (FR)). European Space Agency, 75 - Paris (France). Jun 1988. (CONF-8804199–: Celebratory symposium on a decade of UV astronomy with the IUE satellite, Greenbelt, Maryland, USA, 12 Apr 1988). In *Decade of UV astronomy with the IUE satellite. Volume 1 Proceedings of a celebratory symposium.* Order Number DE89012116/JAW. Available from NTIS (US Sales Only), PC A18/MF A01.

The IUE satellite has supplied several thousands of high resolution stellar spectra which has only partially been interpreted in terms of synthetic spectra of relevant wavelength intervals. In many cases the comparison between observed and computed spectra gives poor results. To establish the real needs to interpret correctly a high resolution IUE spectrum we perform a rough estimation of what would be the abundance or the f minimal values that correspond to isolated lines in the limit of detection given by instrumental resolution. In this way, we stress the need to develop the determination or calculation of atomic data concerning very weak spectral lines. Thus, with more complete and reliable atomic data, systematic synthetic spectra calculations could lead to better understand the physical conditions of stellar atmospheres.

34793 (ESA-SP–281, pp. 389-392) **IUE spectral atlas of two normal B stars: πCet and νCap (125-200 nm).** Artru, M.C. (Observatoire de Paris, Section de Meudon, 92 (FR)); Borsenberger, J.; Lanz, T. European Space Agency, 75 - Paris (France). Jun 1988. (CONF-8804199–: Celebratory symposium on a decade of UV astronomy with the IUE satellite, Greenbelt, Maryland, USA, 12 Apr 1988). In *Decade of UV astronomy with the IUE satellite. Volume 1 Proceedings of a celebratory symposium.* Order Number DE89012116/JAW. Available from NTIS (US Sales Only), PC A18/MF A01.

An atlas for two normal B stars, πCet (HD17081, B7V) and νCap (HD192432, B9.5V) is prepared in the range 125-200 nm. By means of an improved software to process the IUE images and by the coaddition of about ten available high-resolution images, the best possible resolution and signal/noise ratio are obtained. The identification of the lines is based on updated laboratory lists with a selection of the dominant contributors for each absorption line. About 80% of the measured lines have a definite identification.

34794 (IC–89/2) **Studying shocks in model astrophysical flows.** Chakrabarti, S.K. International Centre for Theoretical Physics, Trieste (Italy). Jan 1989. 9p. Order Number DE89618786/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

We briefly discuss some properties of the shocks in the existing models for quasi two-dimensional astrophysical flows. All of these models which allow the study of shock analytically have some unphysical characteristics due to inherent assumptions made. We propose a hybrid model for a thin flow which has fewer unpleasant features and is suitable for the study of shocks. (author). 5 refs.

34795 (INIS-BR–1548) **Photographic surface photometry of NGC 2855 and NGC 6771 galaxies.** Schroeder, M. de F.S. Rio Grande do Sul Univ., Porto Alegre (Brazil). Inst. de Fisica. 1984. 139p. (In Portuguese). Order Number DE89618825/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Photographic surface photometry in the BV system was carried out two Southern SO's galaxies, NGC 2855 and NGC 6771. B and V isophote maps were obtained as well as geometric and integrated parameters as position angles, inclination, diameters, magnitudes and integrated colors. Each luminosity profile was decomposed into bulge and disk contributions, each component being fitted to convenient laws. For NGC 2855 de Vaucouleurs law described well the bulge whereas the disk showed an exponential distribution. For NGC 6771 the barred nuclear bulge as well as the disk was best fitted by exponential laws. Additional luminosity components due to an inner fragmented ring were identified in NGC 2855 and due to both a quite prominent lens and well defined ring in NGC 6771. In this galaxy the minor axis, oriented almost edge-on, present clues of another luminosity component besides the bulge and the thin disk. For both galaxies the disk central surface brightness was found to be fainter than the standard value observed by Freeman. The fitting parameters were used to determine the bulge-to-disk luminosity ratios as well as their contribution to total luminosity. The domination by the bulge light over the disk light was clear in both galaxies. From the B and V luminosity profile the color gradients were estimated. For both objects the local color indices decreased from inner to outer regions, this effect being relatively smooth in NGC 2855 and more prominent in NGC 6771.

34796 (INIS-mf–11450) **Astrophysics. Proceedings. Vol. 5.** Harmanec, P. (ed.). Ceskoslovenska Akademie Ved, Ondrejov (Czechoslovakia). Astronomicky Ustav. 1987. 341p. (CONF-8708269–: 10. European regional astronomy meeting of the IAU, Prague, Czechoslovakia, 24-29 Aug 1987). Order Number DE89617701/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

Volume 5 of the proceedings contains 62 papers of which 61 have been incorporated in INIS. They are divided by subject into several groups: early-type stars, late-type stars, binaries and multiple systems, theoretical considerations, ultraviolet stellar spectra, high energy astrophysics and binary stars. Many papers dealt with variable stars, star development and star models. (M.D.). 200 figs., 38 tabs., 1189 refs.

34797 (INIS-mf–11450, pp. 13-20) **Time-scales and physical processes.** Baglin, A. (Observatoire de Nice, 06 (France)). Ceskoslovenska Akademie Ved, Ondrejov (Czechoslovakia). Astronomicky Ustav. 1987. (CONF-8708269–: 10. European regional astronomy meeting of the IAU, Prague, Czechoslovakia, 24-29 Aug 1987). In *Astrophysics. Proceedings. Vol. 5.* Order Number DE89617701/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

Following general remarks, a few observed timescales in stars discussed at this colloquium are presented. Characteristic times in stellar models for the internal structure and the outer layers are reviewed. Examples of mode identification are discussed. In the low frequency domain, the situation is quite simple. But the high frequency region is more difficult to decipher as many phenomena occupy the same domain: orbital motion, rotation of a non-uniform body, spheroid g modes and Rossby waves. The linear framework is not always relevant and the nonlinear dynamics is more difficult to characterize. In general, timescales alone cannot permit a mode identification. Additional information on energy content, amplitudes, coherence, multiplicity, stationarity is necessary for discrimination of the various possibilities. (author). 15 figs., 2 tabs., 20 refs.

34798 (INIS-mf–11450, pp. 25-32) **Evidence of rapid variability in early-type stars.** Koubsky, B. (Ceskoslovenska Akademie Ved, Ondrejov (Czechoslovakia). Astronomicky Ustav). Ceskoslovenska Akademie Ved, Ondrejov (Czechoslovakia). Astronomicky Ustav. 1987. (CONF-8708269–: 10. European regional astronomy meeting of the IAU, Prague, Czechoslovakia, 24-29 Aug 1987). In *Astrophysics. Proceedings. Vol. 5.* Order Number DE89617701/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

Though evidence of rapid variability in early-type stars is rather old there is more recent information on this subject. This information explosion started with the introduction of new detectors capable of detecting even very subtle variations. Old evidence based on important changes remains. Different types of rapid variability in O, B, WR and CP2 stars, and their relations are discussed. (author). 85 refs.

34799 (INIS-mf–11450, pp. 33-35) **Incidence of absorption line profile variability among the O stars.** Fullerton, A.W. (Toronto Univ., ON (Canada)); Bolton, C.T.; Gies, D.R. Ceskoslovenska Akademie Ved, Ondrejov (Czechoslovakia). Astronomicky Ustav. 1987. (CONF-8708269–: 10. European regional astronomy meeting of the IAU, Prague, Czechoslovakia, 24-29 Aug 1987). In *Astrophysics. Proceedings. Vol. 5.* Order Number DE89617701/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

Preliminary results are presented from a spectroscopic survey for absorption line profile variations among the O stars. Data consist of more than 1000 high quality spectra of 46 bright O stars witch were obtained with sufficient time resolution to sample variations with timescales of hours to days. Most spectral types and luminosity classes are represented. About 31% of these stars exhibit photospheric variability which probably arises from organized velocity fields. The remaining stars are either constant (31% of the sample) or possess variability associated with their winds (43% of the sample, including 2 of the photospheric variables). Examples are presented illustrating each of these classes of behavior, and preliminary implications and future directions of this work are discussed. (author). 4 figs., 11 refs.

34800 (INIS-mf–11450, pp. 39-41) **Variability in the stellar wind of 68 Cygni - not "shells" or "puffs", but streams.** Prinja, R.K. (University Coll., London (UK). Dept. of Physics and Astronomy); Howarth, I.D. Ceskoslovenska Akademie Ved, Ondrejov (Czechoslovakia). Astronomicky Ustav. 1987. (CONF-8708269–: 10. European regional astronomy meeting of the IAU, Prague, Czechoslovakia, 24-29 Aug 1987). In *Astrophysics. Proceedings. Vol. 5.* Order Number DE89617701/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

Results are presented from a study of variability in the stellar wind of 68 Cygni [O7.5 III((f))], based on 33 International Ultraviolet Explorer high resolution spectra taken over $\sim$ 7 days. Significant changes are evident in the Si IV resonance line profiles on timescales as short as $\sim$ 1 hour, characterized by broad absorption enhancements at relatively low velocity (0.5 to 0.7 of the terminal velocity, v_∞) which evolve into high velocity discrete absorption components (at $\geq 0.8\ v_\infty$) over a period of $\sim$ 1 day. The recurrence timescale for the appearance of the broad features is $\sim$ 15 to 20 hours. Three well monitored consecutive sequences of progressive opacity enhancements are described. Their properties are parameterized and incorporated into a self-consistent phenomenological model where the opacity enhancements and "underlying" wind are radiatively coupled. The model results show that the absorption enhancements do not propagate from the photosphere in any simple way, and are not due to spherically symmetric phenomena. We conclude that the discrete absorption variability in 68 Cyg is not due to "shells" or "puffs" of matter, but instead arise from material passing through perturbations in the flow, which may be illustrated in terms of spirally wound-up streams. (author). 6 figs., 9 refs.

34801 (INIS-mf–11450, pp. 45-48) **Short-time scale variability in some Be stars.** Hubert, H. (Observatoire de Paris, Section de Meudon, 92 (France)); Dagostinoz, B.; Hubert, A.M.; Floquet, M. Ceskoslovenska Akademie Ved, Ondrejov (Czechoslovakia). Astronomicky Ustav. 1987. (CONF-8708269–: 10. European regional astronomy meeting of the IAU, Prague, Czechoslovakia, 24-29 Aug 1987). In *Astrophysics. Proceedings. Vol. 5.* Order Number DE89617701/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

The short-time scale spectroscopic variability of some Be stars was investigated with an optical fiber spectrograph and a CCD camera. The following findings were made on the timescale of hours and days: (1) weak changes in the Hα emission line profile of γ Cas; (2) changes in the structure and the intensity of the Hα emission line core and sometimes in the wings of the HeI λ 6678 of phi Per; (3) notable variations in the HeI photospheric line profile λ 6678 and in the core of the Hα absorption line of o And, which do not seem correlated with the photometric period of 1.57 days given by Harmanec (1984). (author). 5 figs., 9 refs.

34802 (INIS-mf–11450, pp. 49-52) **Analysis of nonradial oscillations of rapidly rotating δ Scuti stars.** Walker, G. (British Columbia Univ., Vancouver, BC (Canada). Dept. of Geophysics and Astronomy); Yang, S.; McDowall, G.; Fahlman, G. Ceskoslovenska Akademie Ved, Ondrejov (Czechoslovakia). Astronomicky Ustav. 1987. (CONF-8708269–: 10. European regional astronomy meeting of the IAU, Prague, Czechoslovakia, 24-29 Aug 1987). In *Astrophysics. Proceedings. Vol. 5.* Order Number DE89617701/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

The authors reported elsewhere the discovery of apparently high-degree nonradial oscillations for the four rapidly rotating ($\sim$120 kms^{-1}) δ Scuti stars: 21 Mon, κ^2 Boo, ν UMa, and o^1 Eri. Here some of the techniques are discussed which were used to isolate and to analyze the time varying components ($\sim$1% continuum) of the line profiles. They are best seen after subtraction of an average, filtered spectrum. For the δ Scuti stars, periodograms of the residual spectra show several peaks, some of which can be identified with the degrees of oscillation found in the authors' preliminary analysis. In the latter, values of /m/were estimated from the sub-feature accelerations and delay in transit of the features. While one mode tends to dominate it is clear that often more than one is present. The sub-features are not always equally spaced and they can show phase changes and doubling. While nonradial pulsation provides an adequate, general description of the phenomena, probably only part of something more complex is being seen. The immediate challenge is to combine the results from many lines plus higher spectral resolution to improve the visibility of the time varying features by at least an order of magnitude. (author). 6 figs., 1 tab., 19 refs.

34803 (INIS-mf–11450, pp. 53-57) **Variability of the runaway star 53 Arietis.** Sterken, C. (Brussels Univ. (Belgium). Inst. d'Astronomie et d'Astrophysique). Ceskoslovenska Akademie Ved, Ondrejov (Czechoslovakia). Astronomicky Ustav. 1987. (CONF-8708269–: 10. European regional astronomy meeting of the IAU, Prague, Czechoslovakia, 24-29 Aug 1987). In *Astrophysics. Proceedings. Vol. 5.* Order Number DE89617701/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

Photometric and spectrographic observations of the runaway star 53 Ari confirm that the star does not exhibit detectable light- and radial velocity variations. The star is definitely not a beta Cephei star. (author). 6 figs., 12 refs.

34804 (INIS-mf–11450, pp. 59-61) **Searching relativistic stars among O-B runaways I: V568 Cyg = HD 197419.** Blanco, C. (Catania Univ. (Italy). Osservatorio Astrofisico); Mammano, A.; Baratta, G.; Coluzzi, R.; Croce, V.; Margoni, R.; Stagni, R.; Munari, U.; Dalmeri, I. Ceskoslovenska Akademie Ved, Ondrejov (Czechoslovakia). Astronomicky Ustav. 1987. (CONF-8708269–: 10. European regional astronomy meeting of the IAU, Prague, Czechoslovakia, 24-29 Aug 1987). In *Astrophysics. Proceedings.*

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V568 Cyg was observed photometrically, spectroscopically and photographically during a campaign on O-B runaways. These may contain either postsupernova binaries or stars dynamically ejected from young associations. Whereas even its variability was doubtful, photometric minima deeper from V to U as well as strong inversion of color indexes were recorded, the star becoming redder as the minimum got deeper. New transient H_α emission episodes were observed. The equivalent widths of absorption lines of hydrogen, except H_α, change in a correlated way reaching their lowest value sometimes at photometric minima. Eclipse of a hot object with a possible disk, by a late type giant in an eccentric orbit, seems the most viable explanation. The ephemeris J.D. 2446641.5+152.12 days may help the search for further primary minima. (author). 3 figs., 6 refs.

34805 (INIS-mf–11450, pp. 63-65) **13-color photometry of HD 184279.** Alvarez, M. (Instituto de Astronomia, Ensenada (Mexico)); Ballereau, D. Ceskoslovenska Akademie Ved, Ondrejov (Czechoslovakia). Astronomicky Ustav. 1987. (CONF-8708269–: 10. European regional astronomy meeting of the IAU, Prague, Czechoslovakia, 24-29 Aug 1987). In *Astrophysics. Proceedings. Vol. 5.* Order Number DE89617701/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

From the analysis of the 13-color photometry and spectroscopy of HD 184279 (V 1294 Aql), it was found that for the last 10 years, this star presents a pseudo period of 5.0 years both in light and radial velocity. There is a phase difference of 0.148 P (8.9 months) between the maximum of light and the minimum of radial velocity. The magnitude of the star changes by 0.4 mag. and the radial velocity shows a range of 185 km/sec. A comparison with theoretical models gives a $T_{eff} \leq 28{,}700$ K with log $g \leq 4.0$ in agreement with spectroscopic determinations. The star is reaching the maximum of light and some shell features are decreasing, a probable indication that the star may return to a quiescent stage on its evolution, or it will continue the cyclic behavior that has characterized it for the last 10 years. Its observation in UV and IR wavelenghts should be very important to measure the wind that may be present in the well developed shell surrounding the star. (author). 3 figs., 1 tab., 18 refs.

34806 (INIS-mf–11450, pp. 67-68) **Photometric and spectroscopic study of AZ Canis Minoris.** Bakos, G.A. (Waterloo Univ., ON (Canada). Dept. of Physics); Tremko, J. Ceskoslovenska Akademie Ved, Ondrejov (Czechoslovakia). Astronomicky Ustav. 1987. (CONF-8708269–: 10. European regional astronomy meeting of the IAU, Prague, Czechoslovakia, 24-29 Aug 1987). In *Astrophysics. Proceedings. Vol. 5.* Order Number DE89617701/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

Photometric and spectrographic observations of this δ Sct variable are presented. A comparison of photometric data over a period of 17 years indicates a binary nature of this variable. A tentative period of seven years was derived. Applying relations applicable to this group of stars shows that this variable is a giant star with a radius of about 2.6 R_{Sun} pulsating in its first overtone. (author). 2 figs., 2 tabs., 3 refs.

34807 (INIS-mf–11450, pp. 69-70) **Multifrequency analysis of the short-term variable Be star KY And.** Pavlovski, K. (Zagreb Univ. (Yugoslavia)). Ceskoslovenska Akademie Ved, Ondrejov (Czechoslovakia). Astronomicky Ustav. 1987. (CONF-8708269–: 10. European regional astronomy meeting of the IAU, Prague, Czechoslovakia, 24-29 Aug 1987). In *Astrophysics. Proceedings. Vol. 5.* Order Number DE89617701/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

Broad-band UBV light and color observations of KY And obtained in September 1982 at the Hvar Observatory were analyzed. It was found that no single frequency satisfied the data well enough, hence, a multifrequency fit was determined. (author). 2 figs., 12 refs.

34808 (INIS-mf–11450, pp. 71-74) **Search for rapid variability in spectrum of Alpha Andromedae. (Progress report).** Zverko, J. (Slovenska Akademia Vied, Skalnate Pleso (Czechoslovakia). Astronomicky Ustav); Ziznovsky, J.; Zboril, M.; Hric, L.; Polosukhina, N.; Malanushenko, V.; Bychkov, V.; Iliev, I. Ceskoslovenska Akademie Ved, Ondrejov (Czechoslovakia). Astronomicky Ustav. 1987. (CONF-8708269–: 10. European regional astronomy meeting of the IAU, Prague, Czechoslovakia, 24-29 Aug 1987). In *Astrophysics. Proceedings. Vol. 5.* Order Number DE89617701/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

Radial velocities of Hγ - H9 and CA II K lines on 27 high dispersion (0.27 nm/mm)spectrograms of the HgMn-star Alpha Andromedae were measured. While radial velocities of Balmar lines show no significant changes, radial velocities,of the Ca II K line vary in the limits from 5 to 13 km/s. A frequency analysis of the Ca II K radial velocity values leads to two different frequencies of 27.86 and 35.20 c/d. Their superposition results in a 196 min beat-phenomenon period. Halfwidth of the calcium line varies in the way which could be explained by nonradial oscillations. (author). 3 figs., 1 tab., 8 refs.

34809 (INIS-mf–11450, pp. 77-87) **Variability in chromospherically active stars - at all time scales.** Hall, D.S. (Vanderbilt Univ., Nashville, TN (USA)). Ceskoslovenska Akademie Ved, Ondrejov (Czechoslovakia). Astronomicky Ustav. 1987. (CONF-8708269–: 10. European regional astronomy meeting of the IAU, Prague, Czechoslovakia, 24-29 Aug 1987). In *Astrophysics. Proceedings. Vol. 5.* Order Number DE89617701/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

Chromospheric activity is found in ten types of stars, both single and binary. Variability at many time scales is reviewed, from minutes to centuries. The emphasis is on what is not understood, incorrectly understood, and understood but not appreciated. Observational results in hand include photometry, spectroscopy, spectrophotometry, speckle interferometry, magnetic fields, and orbital period variations. Certain physical mechanisms responsible for variability are discussed, making the distinction between the well-established, the suspected, and the possible. Specific topics include flares, rotation, differential rotation, synchronization, circularization, starspots, spot models, migration periods, spot cycles, magnetic activity cycles, sector structure, Maunder minima, pulsation, light curve solutions, convective envelope changes, mass transfer, mass loss, and orbital period variations. Specific directions for future research are identified. (author). 2 tabs., 97 refs.

34810 (INIS-mf–11450, pp. 89) **Stellar activity.** Rodono, M. (Catania Univ. (Italy). Osservatorio Astrofisico). Ceskoslovenska Akademie Ved, Ondrejov (Czechoslovakia). Astronomicky Ustav. 1987. (CONF-8708269–: 10. European regional astronomy meeting of the IAU, Prague, Czechoslovakia, 24-29 Aug 1987). In *Astrophysics. Proceedings. Vol. 5.* Order Number DE89617701/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

STELLAR ACTIVITY/stellar atmospheres; ROTATION; STARS

34811 (INIS-mf–11450, pp. 91-94) **Rapid time variability in the short-period RS CVn-type binary SV Camelopardalis.** Scaltriti, F. (Osservatorio Astronomico di Torino, Pino Torinese (Italy)); Busso, M.; Corcione, L. Ceskoslovenska Akademie Ved, Ondrejov (Czechoslovakia). Astronomicky Ustav. 1987. (CONF-8708269–: 10. European regional astronomy meeting of the IAU, Prague, Czechoslovakia, 24-29 Aug 1987). In *Astrophysics. Proceedings. Vol. 5.* Order Number DE89617701/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

The eclipsing binary SV Cam shows photometric features that suggest its membership of the RS CVn group. The existing light curves (covering the period 1947-1986) were analyzed in order to isolate the contribution of the wave-like distortion; all the observations support the presence of an activity cycle, with a duration of about 10 years. By suppressing the contribution due to stellar activity an "average" light curve was derived cleaned from the effects of spots; this light curve was analyzed by the Wood computer code to get the physical parameters of the system. (author). 2 figs., 3 tabs., 15 refs.

34812 (INIS-mf–11450, pp. 95-98) **Starspot proper motion in HK Lac.** Olah, K. (Konkoly Observatory, Budapest (Hungary)); Holl, A.; Gesztelyi, L. Ceskoslovenska Akademie Ved, Ondrejov (Czechoslovakia). Astronomicky Ustav. 1987. (CONF-8708269–: 10. European regional astronomy meeting of the IAU, Prague, Czechoslovakia, 24-29 Aug 1987). In *Astrophysics. Proceedings. Vol. 5.* Order Number DE89617701/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

A recent paper (Olah et al., 1985) showed that the active areas of HK Lac exhibited sometimes small and sometimes large scale motions. In the case of the Sun it is well known that new spots exhibit large proper motions while the old ones move almost together with the surrounding photosphere. On HK Lac both a newly formed active area and an existing old one showed concurrent rapid motions. A possible interpretation of this phenomenon is that new spots appeared in both the new and the old active areas simultaneously. This time coincidence may be accidental but if spots originate in deeper layers, then spots of common deep origin may appear in remote places of the stellar surface at the same time. Similar phenomena are seen on the Sun when there is simultaneous emergence of new flux in various parts of an extended active region (Zirin, 1983). The distribution of the active areas on the surface of HK Lac during the past eight years is discussed. (author). 3 figs., 10 refs.

34813 (INIS-mf–11450, pp. 99-101) **Energy distribution monitoring of the T Tauri are RU Lupi.** Giovannelli, F. (Consiglio Nazionale delle Ricerche, Frascati (Italy). Lab. di Astrofisica Spaziale); Vittone, A.A.; Errico, L.; Rossi, C. Ceskoslovenska Akademie Ved, Ondrejov (Czechoslovakia). Astronomicky Ustav. 1987. (CONF-8708269–: 10. European regional astronomy meeting of the IAU, Prague, Czechoslovakia, 24-29 Aug 1987). In *Astrophysics. Proceedings. Vol. 5.* Order Number DE89617701/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

Within the framework of a large campaign of coordinated multifrequency observations of the T Tauri star RU Lupi, simultaneous UV, optical and IR energy distributions secured in the years 1984-86 are presented. The observations were carried out with the International Ultraviolet Explorer satellite and European Souther Observatory optical and IR telescopes. Strong variations on different timescales were detected in UV and optical regions. On June 30, 1986 a large flare was observed. An analysis of the different energy distributions indicates that the variability of RU Lupi is mainly due to a strong activity in the surface layers of the star. (author). 1 fig., 14 refs.

34814 (INIS-mf–11450, pp. 103-105) **Search of tidal interaction in the binary system λ And.** Glebocki, R. (Gdansk Univ. (Poland)); Bielicz, E.; Pastuszka, Z.; Sikorski, J. Ceskoslovenska Akademie Ved, Ondrejov (Czechoslovakia). Astronomicky Ustav. 1987. (CONF-8708269–: 10. European regional astronomy meeting of the IAU, Prague, Czechoslovakia, 24-29 Aug 1987). In *Astrophysics. Proceedings. Vol. 5.* Order Number DE89617701/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

31 UV spectra obtained with the LWR camera of the International Ultraviolet Explorer satellite in the period 1978-83 were analyzed. Changes of Mg II h and k emissions are evident but there is no evident correlation between emission intensity of Mg II and orbital or photometric phase. Using three various methods of analysis of possible periodicity in variations of Mg II h and k emission intensities real changes were found in h+k fluxes with periods equal to the half of the orbital one, 0.5 P_{orb}=10.2606 d. This effect is interpreted as being evidence of the direct influence of tidal interaction of secondary component on the chromospheric structure of the primary. An evident minimum of the Mg II h and k intensity is observed when the tides are on the line of sight and a maximum when both tidal bulges are visible. The difference between maximum and minimum of total k line flux is equal to about 20%, while the shape of the profile is practically unchanged. (author). 4 figs., 1 tab., 6 refs.

34815 (INIS-mf–11450, pp. 107-109) **Flare activity on HD 12211.** Rovithis, P. (Astronomical Institute, National Observatory of Athens (Greece)); Rovithis-Livaniou, H. Ceskoslovenska Akademie Ved, Ondrejov (Czechoslovakia). Astronomicky Ustav. 1987. (CONF-8708269–: 10. European regional astronomy meeting of the IAU, Prague, Czechoslovakia, 24-29 Aug 1987). In *Astrophysics. Proceedings. Vol. 5.* Order Number DE89617701/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

The flare-like phenomena observed in the eclipsing binary star HD 12211 are presented. (author). 2 figs., 15 refs.

34816 (INIS-mf–11450, pp. 113) **Fast variability in low-mass X-ray binaries.** Paradijs, van J. (Amsterdam Univ. (Netherlands)). Ceskoslovenska Akademie Ved, Ondrejov (Czechoslovakia). Astronomicky Ustav. 1987. (CONF-8708269–: 10. European regional astronomy meeting of the IAU, Prague, Czechoslovakia, 24-29 Aug 1987). In *Astrophysics. Proceedings. Vol. 5.* Order Number DE89617701/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

BINARY STARS/cosmic x-ray sources; COSMIC X-RAY BURSTS; OSCILLATIONS

34817 (INIS-mf–11450, pp. 115-120) **Is Omicron Andromedae a quadruple or even quintuple system?.** Harmanec, P. (I656500CS); Hill, G.M.; Walker, G.A.H.; Dinshaw, N.; Yang, S. Ceskoslovenska Akademie Ved, Ondrejov (Czechoslovakia). Astronomicky Ustav. 1987. (CONF-8708269–: 10. European regional astronomy meeting of the IAU, Prague, Czechoslovakia, 24-29 Aug 1987). In *Astrophysics. Proceedings. Vol. 5.* Order Number DE89617701/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

A historical survey is presented on observations of the Omicron Andromedae star and varous theories presented explaining its spectral variations. Extensive spectroscopic measurements were made. The main lines in the spectra were Fe II 4233, C II 4267, Hγ 4340, a mixture of lines Fe II and Mg II 4385, He I 4388 and Mg II 4391, He I 4471 and Mg II 4481 A. All radial velocities of the stronger Mg II component were analyzed. It was proved that a companion to Omicron Andromedae is a double-line spectroscopic binary with an orbital period of 33.085 days. Multiplicity of paticular Be stars can be responsible for some of the spectral variations observed and for the formation of the Be envelope via interaction between the stars. (M.D.). 4 figs., 4 tabs., 44 refs.

34818 (INIS-mf–11450, pp. 121-126) **Rapid spectral variability of massive X-ray binaries and runaways.** Aab, O.E. (AN SSSR, Nizhnij Arkhyz (USSR). Spetsial'naya Astrofizicheskaya Observatoriya). Ceskoslovenska Akademie Ved, Ondrejov (Czechoslovakia). Astronomicky Ustav. 1987. (CONF-8708269–: 10. European regional astronomy meeting of the IAU, Prague, Czechoslovakia, 24-29 Aug 1987). In *Astrophysics. Proceedings. Vol. 5.* Order Number DE89617701/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

During 1976-1986, spectral investigations of the X-ray binary A0535+26=HDE 245770 and the runaway supergiant HD 188209 were carried out with a 6 m telescope. The probable orbit of the Be star HDE 245770 with P=35.1 d is suggested. P. Harmanec has also found a period of 0.187 d in radial velocities. At times of ∼1h H_β emission profiles are variable. A search for pulsar period (P=104 s) in positional and photometric parameters of H_α emission has given no positive results. H_α profiles of the runaway HD 188209 vary from night to night. An orbit of P=18.84 d was found together with probable nonradial pulsations at intervals of ∼1 day. (author). 6 figs., 2 tabs., 29 refs.

34819 (INIS-mf–11450, pp. 127-129) **Duplicity of the Be-star 59 Cyg.** Tarasov, A.E. (AN SSSR, Crimea (USSR). Krymskaya Astrofizicheskaya Observatoriya); Tuominen, I. Ceskoslovenska Akademie Ved, Ondrejov (Czechoslovakia). Astronomicky Ustav. 1987. (CONF-8708269–: 10. European regional astronomy meeting of the IAU, Prague, Czechoslovakia, 24-29 Aug 1987). In *Astrophysics. Proceedings. Vol. 5.* Order Number DE89617701/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

High resolution and high signal to noise ratio CCD observations of 59 Cyg show periodic variations in the radial velocities of the components of the H_α line, i.e., of the absorption component, and of the intensity ratio of the blue and red emission components. The period of 29.14 d suggests duplicity of this star. (author). 2 figs., 1 tab., 5 refs.

34820 (INIS-mf–11450, pp. 133-144) **Theoretical aspects of nonradial pulsations.** Noels, A. (Liege Univ. (Belgium). Inst. d'Astrophysique). Ceskoslovenska Akademie Ved, Ondrejov (Czechoslovakia). Astronomicky Ustav. 1987. (CONF-8708269–: 10. European regional astronomy meeting of the IAU, Prague, Czechoslovakia, 24-29 Aug 1987). In *Astrophysics. Proceedings. Vol. 5.* Order Number DE89617701/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

An introduction to the theory of nonradial modes of oscillations is presented. Evidence of such pulsations can be found in numerous variable stars. Some new results are discussed obtained in stars varying in periods of the order of or more than one hour, namely β

Cep stars, line profile variable stars and WR stars. (author). 11 figs., 72 refs.

34821 (INIS-mf–11450, pp. 145-147) **Some characterization of a nonlinear dynamic in variable stars.** Auvergne, M. (Observatoire de Nice, 06 (France)); Baglin, A. Ceskoslovenska Akademie Ved, Ondrejov (Czechoslovakia). Astronomicky Ustav. 1987. (CONF-8708269–: 10. European regional astronomy meeting of the IAU, Prague, Czechoslovakia, 24-29 Aug 1987). In *Astrophysics. Proceedings. Vol. 5.* Order Number DE89617701/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

Ways are sought for determining the number and properties of differential equations describing a simple model of a variable star. The white dwarf PG 1351+489 was chosen for non linear modelling. The trajectory is reconstructed in phase space. The trajectory projections on different planes are presented graphically. (M.D.) 3 figs., 13 refs.

34822 (INIS-mf–11450, pp. 149-152) **Possible explanation of the occurrence of irregularities in pulsating stars.** Goupil, M.J. (Observatoire de Nice, 06 (France)); Buchler, J.R.; Kovacs, G. Ceskoslovenska Akademie Ved, Ondrejov (Czechoslovakia). Astronomicky Ustav. 1987. (CONF-8708269–: 10. European regional astronomy meeting of the IAU, Prague, Czechoslovakia, 24-29 Aug 1987). In *Astrophysics. Proceedings. Vol. 5.* Order Number DE89617701/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

4 models are presented of one of the sequences exhibiting a tangential bifurcation with effective temperature as the variable parameter. The stellar parameters of these models are presented in solar units: 0.4 for mass, 400 for luminosity and X=0.65, Z=0.05 for chemical composition. Effective temperatures for the four different models are 5960 K, 5950 K, 5940 K and 5890 K. The first model is periodical. In the other three, oscillation changes from periodical to chaotic. The importance is again underlined of identifying the possible chaotic nature of the variability of a star as only a small number of revelant independent variables are needed for modelling its dynamic behavior. (M.D.). 4 figs., 15 refs.

34823 (INIS-mf–11450, pp. 153-156) **Discussion of nonlinear interaction models for stellar pulsations.** Verheest, F. (Ghent Rijksuniversiteit (Belgium)). Ceskoslovenska Akademie Ved, Ondrejov (Czechoslovakia). Astronomicky Ustav. 1987. (CONF-8708269–: 10. European regional astronomy meeting of the IAU, Prague, Czechoslovakia, 24-29 Aug 1987). In *Astrophysics. Proceedings. Vol. 5.* Order Number DE89617701/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

Recent studies have shown interest in the evolution to steady nonlinear pulsation in stellar models. The simplest description is nonresonant interaction between the fundamental and one of its overtones, if one is only interested in the behavior of a few longlived modes. The generic form of coupled-mode equations is not dependent upon a particular stellar model, although the precise determination of the coupling constants for a given stellar model will ultimately be very involved. Qualitative ideas about the eventual evolution of the mode energies give different scenarios, depending mainly on the nonlinear coupling constants and the linear growth rates, if the latter are both positive. According to one scenario, a double-mode pulsator is possible. It is not necessary that all coupling constants be negative, if only the model is well behaved enough to exclude unbounded solutions. With a linearly stable fundamental and a stable overtone another scenario shows a further possibility for a double-mode pulsator, if one of the cross coupling constants is positive, so that the overtone nonlinearly grows before saturating. Such findings show the need for additional theoretical and numerical modelling and a cautious discussion thereof. (author). 13 refs.

34824 (INIS-mf–11450, pp. 157-160) **Radial pulsations and vibrational instability of massive stars.** Kirbiyik, H. (Middle East Technical Univ., Ankara (Turkey)). Ceskoslovenska Akademie Ved, Ondrejov (Czechoslovakia). Astronomicky Ustav. 1987. (CONF-8708269–: 10. European regional astronomy meeting of the IAU, Prague, Czechoslovakia, 24-29 Aug 1987). In *Astrophysics. Proceedings. Vol. 5.* Order Number DE89617701/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

The radial vibrational stabilities have been investigated of some evolutionary models of an initially 60 M_{Sun} star. These models, evolving with mass loss, are in an advanced stage of evolution and burn He in their cores. Calculations were performed for the first and second harmonics as well as for the fundamental mode; some of these models were found to be vibrationally unstable in the fundamental mode. (author). 2 figs., 2 tabs., 33 refs.

34825 (INIS-mf–11450, pp. 161-164) **Smoothing the "smoothing" cubic spline functions.** Andronov, I.L. (2578450DD). Ceskoslovenska Akademie Ved, Ondrejov (Czechoslovakia). Astronomicky Ustav. 1987. (CONF-8708269–: 10. European regional astronomy meeting of the IAU, Prague, Czechoslovakia, 24-29 Aug 1987). In *Astrophysics. Proceedings. Vol. 5.* Order Number DE89617701/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

A new method to investigate periods and their variations is proposed. The phase curve is approximated with the cubic spline function with a fixed number of characteristic points equidistantly distributed phase. Because such a smoothing function depends on the value of the initial epoch it is proposed to use the mean of some spline curves corresponding to various initial epochs for the approximation. The mean quadratic deviation of observations from this best fit curve serves as the test function. The best fit phase deviations of the "season sets" of observations are used to study period variations. (author). 3 figs., 16 refs.

34826 (INIS-mf–11450, pp. 171-175) **Introductory comments to the panel discussion on discrimination between various possible causes of rapid variability in stars.** Harmanec, P. (Ceskoslovenska Akademie Ved, Ondrejov (Czechoslovakia). Astronomicky Ustav). Ceskoslovenska Akademie Ved, Ondrejov (Czechoslovakia). Astronomicky Ustav. 1987. (CONF-8708269–: 10. European regional astronomy meeting of the IAU, Prague, Czechoslovakia, 24-29 Aug 1987). In *Astrophysics. Proceedings. Vol. 5.* Order Number DE89617701/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

The table summarizes briefly the character of luminosity and spectral variability of several different star categories. The possibilities are demonstrated of using the binary star model for interpreting the rapid variations observed. Three principal causes are explained of rapid variability, namely the binary model, the oblique rotator model and the model of radial and nonradial pulsations. (M.D.) 1 fig., 1 tab., 22 refs.

34827 (INIS-mf–11450, pp. 185-192) **UV-stellar spectra - some basic achievements.** Boyarchuk, A.A. (AN SSSR, Moscow (USSR). Astronomicheskij Sovet). Ceskoslovenska Akademie Ved, Ondrejov (Czechoslovakia). Astronomicky Ustav. 1987. (CONF-8708269–: 10. European regional astronomy meeting of the IAU, Prague, Czechoslovakia, 24-29 Aug 1987). In *Astrophysics. Proceedings. Vol. 5.* Order Number DE89617701/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

Observations of stellar spectra in the UV region performed during twenty years are briefly reviewed. Basic achievements have been made in the investigation of interstellar absorption, effective temperatures scale, mass loss, stellar chromospheres and non-stationary stars. (author). 14 figs., 34 refs.

34828 (INIS-mf–11450, pp. 193-198) **Ultraviolet spectra of Algol binaries.** Plavec, M.J. (California Univ., Los Angeles (USA). Dept. of Astronomy). Ceskoslovenska Akademie Ved, Ondrejov (Czechoslovakia). Astronomicky Ustav. 1987. (CONF-8708269–: 10. European regional astronomy meeting of the IAU, Prague, Czechoslovakia, 24-29 Aug 1987). In *Astrophysics. Proceedings. Vol. 5.* Order Number DE89617701/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

A systematic study of the ultraviolet spectra of the Algol-like semidetached binary stars is described. Revision of the traditionally accepted spectral types was found necessary, in most cases toward earlier spectral types. Superionized emission lines seen at total eclipses show interesting differences in intensities. (author). 12 figs., 15 refs.

34829 (INIS-mf–11450, pp. 199) **Far-ultraviolet astronomical observations with the Voyages I and 2 spacecraft.** Polidan, R.S.

(Arizona Univ., Tucson (USA)). Ceskoslovenska Akademie Ved, Ondrejov (Czechoslovakia). Astronomicky Ustav. 1987. (CONF-8708269–: 10. European regional astronomy meeting of the IAU, Prague, Czechoslovakia, 24-29 Aug 1987). In *Astrophysics. Proceedings. Vol. 5.* Order Number DE89617701/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

ULTRAVIOLET SPECTROMETERS/astronomy; ASTRONOMY; VOYAGER SPACE PROBES

34830 (INIS-mf–11450, pp. 201-205) **Ultraviolet spectroscopy of the symbiotic star AG Pegasi.** Chochol, D. (Slovenska Akademia Vied, Skalnate Pleso (Czechoslovakia). Astronomicky Ustav); Komarek, Z.; Vittone, A. Ceskoslovenska Akademie Ved, Ondrejov (Czechoslovakia). Astronomicky Ustav. 1987. (CONF-8708269–: 10. European regional astronomy meeting of the IAU, Prague, Czechoslovakia, 24-29 Aug 1987). In *Astrophysics. Proceedings. Vol. 5.* Order Number DE89617701/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

High resolution UV spectroscopic observations of the binary symbiotic star AG Peg obtained with the International Ultraviolet Explorer satellite in the period 1978-81 are analyzed. The variability of the fluxes and the radial velocities of emission lines according to orbital phase are presented. The observations support a binary model with mass transfer from a hot rotationally unstable subdwarf to a cool M giant. (author). 5 figs., 2 tabs., 20 refs.

34831 (INIS-mf–11450, pp. 207-210) **Stellar winds in A-type supergiants.** Talavera, A. (IUE Observatory, E.S.A., Madrid (Spain)); Gomez de Castro, A.I. Ceskoslovenska Akademie Ved, Ondrejov (Czechoslovakia). Astronomicky Ustav. 1987. (CONF-8708269–: 10. European regional astronomy meeting of the IAU, Prague, Czechoslovakia, 24-29 Aug 1987). In *Astrophysics. Proceedings. Vol. 5.* Order Number DE89617701/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

In a previous study of the A type supergiants observed with International Ultraviolet Explorer, these stars were divided into two groups: the most luminous ones which showed clear evidence of stellar wind and mass loss in their line profiles, and the less luminous ones which did not show these characteristics. New observations of some A supergiants confirm the difference between these two groups. Moreover the less luminous (Ib) A type supergiants do show weak signs of wind and mass loss compared with the most luminous A supergiants and their variation is more spectacular. (author). 3 figs., 3 tabs., 5 refs.

34832 (INIS-mf–11450, pp. 211-214) **Calibrated IUE LWR low resolution spectra of G-type stars.** Malagnini, M.L. (Astronomical Observatory, Trieste (Italy)); Morossi, C.; Valente, T.; Rossi, L. Ceskoslovenska Akademie Ved, Ondrejov (Czechoslovakia). Astronomicky Ustav. 1987. (CONF-8708269–: 10. European regional astronomy meeting of the IAU, Prague, Czechoslovakia, 24-29 Aug 1987). In *Astrophysics. Proceedings. Vol. 5.* Order Number DE89617701/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

An example is presented of the main features of the Atlas of calibrated IUE LWR low resolution spectra of non-supergiant G type stars whose preparation is now in progress. The source of references for the relevant astrophysical data is the Set of Identifications, Measurements and Bibliography for Astronomical Data (SIMBAD), available through the C.D.S. (Strasbourg, France). (author). 1 fig.

34833 (INIS-mf–11450, pp. 223-226) **Is the Vela pulsar associated with the Vela SNR?.** Bignami, G.F. (Consiglio Nazionale delle Ricerche, Milan (Italy)); Caraveo, P.A. Ceskoslovenska Akademie Ved, Ondrejov (Czechoslovakia). Astronomicky Ustav. 1987. (CONF-8708269–: 10. European regional astronomy meeting of the IAU, Prague, Czechoslovakia, 24-29 Aug 1987). In *Astrophysics. Proceedings. Vol. 5.* Order Number DE89617701/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

Optical data taken in Jan 87 from La Silla compared with the discovery plate of 1975.2 show no proper motion for PSR 0833-45 while a very significant one was expected if the pulsar originated in the center of the Vela SNR which had so far been associated with it. Data yield a good estimate of the position of the parent SN event, highly assymetric with respect to the present SNR and incompatible with all the Vela "centers" considered so far at various wavelengths. If the PSR/SNR association is to be maintained there must either be an extreme asymmetry of the SNR or both objects are much older than has been believed so far. Both alternatives, however, doubts on the reality of this classic SNR/pulsar association. (author). 2 figs., 27 refs.

34834 (INIS-mf–11450, pp. 227-237) **Search for linear polarization in gamma-ray sources: possible evidence for the Vela pulsar.** Caraveo, P.A. (Consiglio Nazionale delle Ricerche, Milan (Italy)); Bignami, G.F.; Vacanti, G.; Mitrofanov, I. Ceskoslovenska Akademie Ved, Ondrejov (Czechoslovakia). Astronomicky Ustav. 1987. (CONF-8708269–: 10. European regional astronomy meeting of the IAU, Prague, Czechoslovakia, 24-29 Aug 1987). In *Astrophysics. Proceedings. Vol. 5.* Order Number DE89617701/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

The azimuthal distribution of planes containing e^+/e^- pairs from high-energy photon materialization is reminiscent, through a quadrupole anisotropy, of the degree and position angle of linear polarization of the incident photons. Data on open pairs in the COS-B spark chamber are used in a search for such an effect in >50 MeV photons from bright sources, such as Vela, Crab, Geminga and a reference galactic plane region in Cygnus. After a description of the method and the related simulations and tests, the analysis of available data shows no anisotropy for the other sources but for the Vela pulsar a low-chance-probability effect is found apparently implying a high (~100%) degree of linear polarization fot the Vela photons. This is discussed in light of the physics of the production mechanisms as well as of their geometry. (author). 8 figs., 1 tab., 24 refs.

34835 (INIS-mf–11450, pp. 239-240) **Search for optical flashes from gamma-ray burst sources.** Hudec, R. (Ceskoslovenska Akademie Ved, Ondrejov (Czechoslovakia). Astronomicky Ustav); Borovicka, J.; Peresty, R.; Valnicek, B. Ceskoslovenska Akademie Ved, Ondrejov (Czechoslovakia). Astronomicky Ustav. 1987. (CONF-8708269–: 10. European regional astronomy meeting of the IAU, Prague, Czechoslovakia, 24-29 Aug 1987). In *Astrophysics. Proceedings. Vol. 5.* Order Number DE89617701/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

Preliminary results of an extended program of examination of the Ondrejov and Sonneberg plate collections for possible optical counterparts to gamma-ray bursters are presented. One optical image was found on 3 different plates in the same position suggesting it may be related to the 25 B March 1979 gamma-ray burster. Results of both archival and time-correlated searches are discussed for GRBS and for the Perseus Flasher. (author). 13 refs.

34836 (INIS-mf–11450, pp. 251-261) **Binary evolution.** Loore, C. de (Brussels Univ. (Belgium). Inst. d'Astronomie et d'Astrophysique). Ceskoslovenska Akademie Ved, Ondrejov (Czechoslovakia). Astronomicky Ustav. 1987. (CONF-8708269–: 10. European regional astronomy meeting of the IAU, Prague, Czechoslovakia, 24-29 Aug 1987). In *Astrophysics. Proceedings. Vol. 5.* Order Number DE89617701/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

Consideration of mass transfer and mass loss processes allows the explanation of the existence of well determined groups of binaries, such as Algols, cataclysmic variables, massive and low-mass X-ray binaries. The characteristics of these groups are briefly outlined, and evolutionary scenarios are discussed. The importance of detailed observations for advances in evolutionary computations are stressed. It is argued that, although the links between the mentioned groups of binaries and their progenitors is rather well known, the situation is completely different if the detailed evolutionary history for a given system is required. (author). 99 refs.

34837 (INIS-mf–11450, pp. 241) **Optical study of X-ray sources and search for optical counterparts of gamma-ray burst sources at Sonneberg Observatory.** Goetz, W. (Akademie der Wissenschaften der DDR, Sonneberg (German Democratic Republic). Zentralinstitut fuer Astrophysik). Ceskoslovenska Akademie Ved, Ondrejov (Czechoslovakia). Astronomicky Ustav. 1987. (CONF-8708269–: 10. European regional astronomy meeting of the IAU, Prague, Czechoslovakia, 24-29 Aug 1987). In *Astrophysics. Proceedings. Vol. 5.* Order Number DE89617701/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

COSMIC GAMMA BURSTS/visible radiation; COSMIC X-RAY SOURCES/visible radiation; COSMIC GAMMA SOURCES; VARIABLE STARS

34838 (INIS-mf–11450, pp. 263-266) **Model atmospheres of binary components.** Hadrava, P. (Ceskoslovenska Akademie Ved, Ondrejov (Czechoslovakia). Astronomicky Ustav). Ceskoslovenska Akademie Ved, Ondrejov (Czechoslovakia). Astronomicky Ustav. 1987. (CONF-8708269–: 10. European regional astronomy meeting of the IAU, Prague, Czechoslovakia, 24-29 Aug 1987). In *Astrophysics. Proceedings. Vol. 5.* Order Number DE89617701/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

Models of stellar atmospheres are based on the assumption of their plane-parallel or spherical symetry. Violation of this assumption by tides and rotation in close binaries leads to incompatibility of hydrostatic and radiative equilibria. Improvement of model atmospheres in this respect is desirable for simulation of light curves and line profile changes. Moreover, atmospheres of contact components of interacting binaries determine initial conditions of the dynamics of gaseous streams and thereby influence the behavior of the binary system. (author). 5 figs.

34839 (INIS-mf–11450, pp. 267-269) **UBV light curve solutions of TT Her.** Barone, F. (Naples Univ. (Italy). Dipt. di Fisica Nucleare); Mancuso, S.; Milano, L. Ceskoslovenska Akademie Ved, Ondrejov (Czechoslovakia). Astronomicky Ustav. 1987. (CONF-8708269–: 10. European regional astronomy meeting of the IAU, Prague, Czechoslovakia, 24-29 Aug 1987). In *Astrophysics. Proceedings. Vol. 5.* Order Number DE89617701/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

A new method is introduced for solving the light curves of eclipsing binaries based on the Wilson and Devinney (1971) Roche model. An interesting application is made of the method to binary system TT Her. (author). 2 tabs., 14 refs.

34840 (INIS-mf–11450, pp. 271) **Light curve variabilities of close binaries.** Djurasevic, G. (Astronomical Observatory, Belgrade (Yugoslavia)). Ceskoslovenska Akademie Ved, Ondrejov (Czechoslovakia). Astronomicky Ustav. 1987. (CONF-8708269–: 10. European regional astronomy meeting of the IAU, Prague, Czechoslovakia, 24-29 Aug 1987). In *Astrophysics. Proceedings. Vol. 5.* Order Number DE89617701/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

BINARY STARS/least square fit; BRIGHTNESS; VARIATIONS

34841 (INIS-mf–11450, pp. 273-276) **Spectral investigation of eclipsing binary stars at the stage of mass exchange.** Karetnikov, V.G. (Odesskij Gosudarstvennyj Univ., Odessa (Ukrainian SSR)). Ceskoslovenska Akademie Ved, Ondrejov (Czechoslovakia). Astronomicky Ustav. 1987. (CONF-8708269–: 10. European regional astronomy meeting of the IAU, Prague, Czechoslovakia, 24-29 Aug 1987). In *Astrophysics. Proceedings. Vol. 5.* Order Number DE89617701/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

From spectrograms with dispersion 9-37 A/mm the spectral characteristics of eight eclipsing binary stars were studied showing the effects of mass exchange. Spectral types of stars were determined as were temperatures of excitation, parameters of damping, turbulent velocities, electron number densities, chemical composition of stellar atmospheres and displacements of lines in radiation and absorption, variations in characteristics of lines, as a function of phase. It is shown that appreciable deviations of physical conditions from normal ones were not observed. Schemes-models of studied stellar systems are presented and discussed. (author). 4 figs., 1 tab., 28 refs.

34842 (INIS-mf–11450, pp. 277-279) **TW Cassiopeiae - an Algol-type binary.** Horak, T.B. (Institute for Information and Management of Culture, Bratislava (Czechoslovakia)); Chochol, D. Ceskoslovenska Akademie Ved, Ondrejov (Czechoslovakia). Astronomicky Ustav. 1987. (CONF-8708269–: 10. European regional astronomy meeting of the IAU, Prague, Czechoslovakia, 24-29 Aug 1987). In *Astrophysics. Proceedings. Vol. 5.* Order Number DE89617701/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

Photometric light curves of TW Cas do not exhibit any apparent complications. However, careful analysis of the light conditions in the system yielded some contradictory results. An untraditional explanation is suggested. (author). 3 figs., 10 refs.

34843 (INIS-mf–11450, pp. 281-284) **Some methods for solving visual double star orbits with inclination equal to 90 degC.** Abad, A. (Zaragoza Univ. (Spain). Facultad de Ciencias); Elipe, A.; Docobo, J.A. Ceskoslovenska Akademie Ved, Ondrejov (Czechoslovakia). Astronomicky Ustav. 1987. (CONF-8708269–: 10. European regional astronomy meeting of the IAU, Prague, Czechoslovakia, 24-29 Aug 1987). In *Astrophysics. Proceedings. Vol. 5.* Order Number DE89617701/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

Two different analytical techniques are given for solving visual double star orbits with inclination equal to 90 degC. The first is based on Docobo's method, and the second is derived by using the Fourier transform for angular distances. Both techniques are applied to the pairs 19192S2442 and 19338S2339. (author). 10 refs.

34844 (INIS-mf–11450, pp. 285-287) **Statistical properties of visual and eclipsing binaries.** Paolicchi, P. (Pisa Univ. (Italy)); Alongi, M.; Fofi, M.; Scardia, M. Ceskoslovenska Akademie Ved, Ondrejov (Czechoslovakia). Astronomicky Ustav. 1987. (CONF-8708269–: 10. European regional astronomy meeting of the IAU, Prague, Czechoslovakia, 24-29 Aug 1987). In *Astrophysics. Proceedings. Vol. 5.* Order Number DE89617701/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

The catalogues of visual and eclipsing binaries were analyzed by means of a multivariate statistical method, with the purpose of putting into evidence mutual relations between the observed quantities and clustering properties in multi-dimensional space. Preliminary results of the analysis show several interesting features, and a physical interpretation can be attempted. Nevertheless, observational selection effects play an important role. The way back to understanding the formation and evolutionary properties is extremely difficult and unbiased conclusions about fundamental parameters such as the initial period and mass ratio distributions cannot be obtained. (author). 2 figs., 7 refs.

34845 (INIS-mf–11450, pp. 289-291) **Role of angular momentum transfer to determine the mass ratio of binaries.** Paolicchi, P. (Pisa Univ. (Italy)); Bellesi, M.; Ferrini, F.; Bossi, M. Ceskoslovenska Akademie Ved, Ondrejov (Czechoslovakia). Astronomicky Ustav. 1987. (CONF-8708269–: 10. European regional astronomy meeting of the IAU, Prague, Czechoslovakia, 24-29 Aug 1987). In *Astrophysics. Proceedings. Vol. 5.* Order Number DE89617701/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

A thermodynamical approach to the problem of star formation, presented in a previous paper shows how the characteristics of the outcome depend on the initial conditions (thermal and rotational energies) and on the distribution of the angular momentum among the various parts of the system when the last stages of collapse are assumed as adiabatic. In case of a binary outcome the distribution can be expressed in terms of two parameters roughly corresponding to (a) the spin ratio as function of the mass ratio and (b) the fraction of angular momentum involved in the orbital motion. A systematic exploration of these parameters allows to analyze the different types of results. Some preliminary results are presented assuming that both single and binary outcomes have an equilibrium McLaurin ellipsoidal shape not, however, taking into account the possible formation of a system star+protoplanetary disc. (author). 3 figs., 4 refs.

34846 (INIS-mf–11450, pp. 293) **Luminous accretion disks and high ionization emission lines in interacting binaries.** Polidan, R.S. (Arizona Univ., Tucson (USA)). Ceskoslovenska Akademie Ved, Ondrejov (Czechoslovakia). Astronomicky Ustav. 1987. (CONF-8708269–: 10. European regional astronomy meeting of the IAU, Prague, Czechoslovakia, 24-29 Aug 1987). In *Astrophysics. Proceedings. Vol. 5.* Order Number DE89617701/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

ACCRETION DISKS/binary stars; BINARY STARS/emission spectra; ERUPTIVE VARIABLE STARS; IONIZATION; LUMINOSITY; ULTRAVIOLET SPECTRA

34847 (INIS-mf–11450, pp. 295-300) **Models of accretion disks in interacting binaries.** Kriz, S. (Ceskoslovenska Akademie Ved, Ondrejov (Czechoslovakia). Astronomicky Ustav). Ceskoslovenska Akademie Ved, Ondrejov (Czechoslovakia). Astronomicky Ustav. 1987. (CONF-8708269–: 10. European regional astronomy meeting of the IAU, Prague, Czechoslovakia, 24-29 Aug 1987). In *Astrophysics. Proceedings. Vol. 5.* Order Number DE89617701/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

The properties of a standard accretion disk are summarized. Recent models of steady and time dependent disks are discussed. The two-dimensional calculations of accretion flows are examined. (author). 6 figs., 90 refs.

34848 (INIS-mf–11450, pp. 215-219) **Interstellar UV lines.** Harris, A.W. (Rutherford Appleton Lab., Chilton (UK)). Ceskoslovenska Akademie Ved, Ondrejov (Czechoslovakia). Astronomicky Ustav. 1987. (CONF-8708269–: 10. European regional astronomy meeting of the IAU, Prague, Czechoslovakia, 24-29 Aug 1987). In *Astrophysics. Proceedings. Vol. 5.* Order Number DE89617701/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

The use of different types of star as background sources for UV absorption line studies of the interstellar medium is reviewed in the context of selected recent investigations of the local interstellar medium, interstellar gas in the galactic disk in general and halo gas. Problems associated with the analysis and interpretation of interstellar absorption lines are highlighted. (author). 3 figs., 30 refs.

34849 (INIS-mf–11450, pp. 301-305) **On the nature of the component stars in Beta Lyrae.** Plavec, M.J. (California Univ., Los Angeles (USA). Dept. of Astronomy). Ceskoslovenska Akademie Ved, Ondrejov (Czechoslovakia). Astronomicky Ustav. 1987. (CONF-8708269–: 10. European regional astronomy meeting of the IAU, Prague, Czechoslovakia, 24-29 Aug 1987). In *Astrophysics. Proceedings. Vol. 5.* Order Number DE89617701/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

An attempt was made to determine the continuous flux distribution separately for the two components of β Lyrae, first from optical spectrophotometric scans, then from ultraviolet spectra. Both components have anomalous flux distribution not matching any standard star. For the primary this is probably due to its Roche lobe filling; the secondary is a disk. (author). 7 figs., 7 refs.

34850 (INIS-mf–11450, pp. 307-310) **On the non-LTE analysis of He I lines in the atmosphere of β Lyr.** Dimitrov, D.L. (Prague Observatory (Czechoslovakia)); Kubat, J. Ceskoslovenska Akademie Ved, Ondrejov (Czechoslovakia). Astronomicky Ustav. 1987. (CONF-8708269–: 10. European regional astronomy meeting of the IAU, Prague, Czechoslovakia, 24-29 Aug 1987). In *Astrophysics. Proceedings. Vol. 5.* Order Number DE89617701/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

Some effects are presented of an increasing He abundance in the stellar atmosphere. The run of b-factors with depth for various He abundances is given as are the theoretical equivalent widths of He I and Balmer lines. The appearance of certain shell lines suggests strong influence from a circumstellar envelope. (author). 2 figs., 3 refs.

34851 (INIS-mf–11450, pp. 311-316) **UV spectra of cataclysmic and symbiotic variables.** Selvelli, P.L. (Osservatorio Astronomico di Trieste (Italy)); Viotti, R. Ceskoslovenska Akademie Ved, Ondrejov (Czechoslovakia). Astronomicky Ustav. 1987. (CONF-8708269–: 10. European regional astronomy meeting of the IAU, Prague, Czechoslovakia, 24-29 Aug 1987). In *Astrophysics. Proceedings. Vol. 5.* Order Number DE89617701/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

UV observations of cataclysmic and symbiotic variables with the International Ultraviolet Explorer (IUE) satellite are making fundamental contribution to our knowledge of the nature of these objects. The study of UV resonance and intercombination lines of the most abundant elements was used to diagnose the physical conditions in the disk, circumstellar region, and ejecta. Most objects display a strong UV continuum which is usually attributed to emission from the hot component and/or from the accretion disk. The exceptionally long lifetime of IUE has allowed the study of these objects during different activity phases. In the recurrent nova T Cr B, dramatic UV variations were observed during phases of optical quiescence. The UV study of the recent outbursts of the symbiotic stars AG Dra, Z And, and PU Vul, and that of CH Cyg during the activity phases associated to the formation of a jet were of particular interest. The results of multi-frequency observations (from ratio to x-rays) of some symbiotic variables, and their implications for the models are also discussed. (author). 57 refs.

34852 (INIS-mf–11450, pp. 317-320) **Radiation of the symbiotic star CH Cygni in the period 1982 -July 1984.** Skopal, A. (Slovenska Akademia Vied, Skalnate Pleso (Czechoslovakia). Astronomicky Ustav); Mikolajewski, M.; Biernikowicz, R. Ceskoslovenska Akademie Ved, Ondrejov (Czechoslovakia). Astronomicky Ustav. 1987. (CONF-8708269–: 10. European regional astronomy meeting of the IAU, Prague, Czechoslovakia, 24-29 Aug 1987). In *Astrophysics. Proceedings. Vol. 5.* Order Number DE89617701/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

Spectroscopic behavior is described of the symbiotic star CH Cygni in the period of the activity 1982 - July 1984. Observed variations of the intensities of the emission lines and absorption shell lines are discussed. An analysis of these lines supports the idea that a few different regions of radiation exist in CH Cygni. Drop in brightness and development of jets are interpreted as the consequence of an accretion disk evolution. (author). 4 figs., 10 refs.

34853 (INIS-mf–11450, pp. 321-324) **Chemically peculiar binary ω UMa with elliptical orbit.** Hric, L. (Slovenska Akademia Vied, Skalnate Pleso (Czechoslovakia). Astronomicky Ustav). Ceskoslovenska Akademie Ved, Ondrejov (Czechoslovakia). Astronomicky Ustav. 1987. (CONF-8708269–: 10. European regional astronomy meeting of the IAU, Prague, Czechoslovakia, 24-29 Aug 1987). In *Astrophysics. Proceedings. Vol. 5.* Order Number DE89617701/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

Results or radial velocity measurements from spectrograms and orbital elements with elliptical orbit computed from them and published data, are presented. It is suggested that light variations could be explained by the eclipsing nature of UMa. Changes of equivalent widths of some lines are interpreted by rotation. (author). 2 figs., 1 tab., 19 refs.

34854 (INIS-mf–11450, pp. 325-329) **On the possibility of taking into account the electromagnetic radiation in the atmospheres of close binary stars.** Kudzej, I. (Humenne People Observatory, Humenne (Czechoslovakia)). Ceskoslovenska Akademie Ved, Ondrejov (Czechoslovakia). Astronomicky Ustav. 1987. (CONF-8708269–: 10. European regional astronomy meeting of the IAU, Prague, Czechoslovakia, 24-29 Aug 1987). In *Astrophysics. Proceedings. Vol. 5.* Order Number DE89617701/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

The calculation procedure of optical characteristics of stellar atmospheres is described for the model of homogeneous partially ionized nonrelativistic isotropic plasma with regard to individual particles collision. Progress is described in the calculation of the refracted electromagnetic radiation of an eclipsed component in the atmosphere of an eclipsing component in the close binary system during total eclipse. The frequencies of the incident electromagnetic wave and the characteristics of the atmosphere layer are indicated in which to real refraction effect in the latter may generate some additional radiation throughout the total eclipse observed in twelve close binary system. (author). 3 figs., 1 tab., 10 refs.

34855 (INIS-mf–11450, pp. 331-332) **Spectroscopic binary XI Cygni.** Onderlicka, B. (Universita J.E. Purkyne, Brno (Czechoslovakia)); Handlirova, D. Ceskoslovenska Akademie Ved, Ondrejov (Czechoslovakia). Astronomicky Ustav. 1987. (CONF-8708269–: 10. European regional astronomy meeting of the IAU, Prague, Czechoslovakia, 24-29 Aug 1987). In *Astrophysics. Proceedings. Vol. 5.* Order Number DE89617701/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

Radial velocity variations of the K supergiant Xi Cygni are investigated on the basis of published as well as new values from spectrograms in the visual and near infrared region obtained in the years 1977-1984 at the Ondrejov, Shemakha, and Crimea observatories. A circular orbit (P=113.3873 days, Tmax=2430214.33 HJD, K1=3.47 km/s, Vo=-20.0 km/s), seems to confirm the period derived

by Parsons (1983). More accurate data are needed and problem of the long period (Reimers 1981) should be investigated. (author). 1 fig., 1 tab., 12 refs.

34856 (INIS-mf–11450, pp. 333-335) **Binary model of HD 94033 and the physical nature of dwarf cepheid.** Jiang, S.Y. (Beijing Astronomical Observatory). Ceskoslovenska Akademie Ved, Ondrejov (Czechoslovakia). Astronomicky Ustav. 1987. (CONF-8708269–: 10. European regional astronomy meeting of the IAU, Prague, Czechoslovakia, 24-29 Aug 1987). In *Astrophysics. Proceedings. Vol. 5.* Order Number DE89617701/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

HD 94033 was discovered by Przybylski in 1975 as a dwarf cepheid with a pulsation period of 86 min. Between 1981 and 1984, it was observed, many times, and its (O-C) values of the time of maxima exhibiting regular variation with a long period of about 9 years were found. Recent observation, to 1987 still fits this variation very well. It is believed to be due to the light-time effect in a binary system. Some physical characteristics of the dwarf cepheid and δ Scuti stars are discussed. (author). 1 fig., 1 tab., 4 refs.

34857 (INIS-mf–11456, pp. 43-50) **Physical and chemical properties of Halley comet.** Vanysek, V. (Karlova Univ., Prague (Czechoslovakia). Fakulta Matematicko-Fyzikalni). Jednota Ceskoslovenskych Matematiku a Fyziku, Prague (Czechoslovakia). 1987. (In Czech). (CONF-8707217–: 9. conference of Czechoslovak physicists, Pardubice, Czechoslovakia, 6-10 Jul 1987). In *Ninth conference of Czechoslovak physicists. Part 1, 2.* Order Number DE89617602/JAW. Available from NTIS (US Sales Only), PC A22/MF A01 - OSTI; INIS.

The importance is explained of comets for the indepth study of processes which preceded the development of the solar system. Briefly summed up is known data on the structure and chemical composition of these bodies on the basis of the complex study of Halley comet. (author). 14 refs.

34858 (INS–721) **Solution of strong CP problem in baby universe theory.** Nielsen, H.B.; Ninomiya, Masao. Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study. Nov 1988. 12p. Order Number DE89778087/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The strong CP problem is solved by use of quantum gravity. It is argued that the coherent state parameters α_i describing the effect of wormholes (baby universes) adjust themselves so as to make the strong interactions CP-invariant. There remains though a small CP breaking so that θ-bar is not exactly zero. The main prediction is that we do not need the axion proposed by Peccei and Quinn.

34859 (INS–727) **Baby universes, fine tuning problems. A theory of everything robbing the throne by killing the rivals.** Nielsen, H.B.; Ninomiya, Masao. Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study. Dec 1988. 41p. Order Number DE89778131/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

We review the recently popular 'theory of baby universes' put forward by Banks, Coleman and Hawking. We then derive the strong CP breaking coefficient θ-bar to be very small, in a similar manner to the derivation of the cosmological constant being zero. A solution for an old controversy concerning the entropy creation in black holes is also discussed. We finally confront the baby universe theory with random dynamics. We conclude that the theory of baby universes is so successful that the essential features are likely true and might have to go into a right theory even if with some troubles at first.

34860 (LAPP-EXP–88-01) **New ideas on the detection of low energy solar neutrinos.** Gonzalez-Mestres, L.; Perret-Gallix, D. Grenoble-1 Univ., 74 - Annecy (France). Lab. de Physique des Particules. Mar 1988. 7p. (CONF-880173–: 22. Moriond workshop on neutrinos and exotic phenomena in particle physics and astrophysics, Les Arcs, France, 23-30 Jan 1988). Order Number DE89781536/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

^{115}In provides an extremely interesting target for real time solar neutrino detection [1]. Its use was proposed by Raghavan [2], based on the reaction: $\nu(E>128keV) + {}^{115}In \rightarrow {}^{115}Sn^{**} + e^-(E_\nu\text{-}128keV)$ where the $^{115}Sn^{**}$ decays to the ground state of ^{115}Sn with a lifetime of 3.3 μS emitting two γ rays (497 keV and 116 keV)[3]. The delayed coincidence should provide a specific signature of solar neutrino events, sharp enough to overcome background problems related to ^{115}In β radioactivity. Real time detection of solar neutrinos with ^{115}In has been proposed by several techniques [4]. We discuss here the possibility of performing such an experiment, focusing on superconducting granules and special scintillators. The concept of 'localized micro-avalanche' should introduce crucial improvements in superheated superconducting granules (SSG) devices and, eventually, make feasible a 4 ton In solar neutrino experiment. The possible use of dedicated scintillating crystals of In compounds is also dealt with, as feasibility studies are under way.

34861 (LAPP-EXP–88-04) **New ideas on the detection of cold dark matter and magnetic monopoles.** Gonzalez-Mestres, L.; Perret-Gallix, D. Grenoble-1 Univ., 74 - Annecy (France). Lab. de Physique des Particules. May 1988. 9p. (CONF-8803113–: 8. Moriond astrophysics meeting on dark matter, Les Arcs, France, 6-13 Mar 1988). Order Number DE89781539/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

Superheated superconducting granules (SSG) provide several interesting targets for cold dark matter detection, not only through coherent scattering off nuclei, but also for Majorana fermions through spin-spin interactions. The concept of 'localized micro-avalanche' should introduce crucial improvements in SSG devices and, eventually, make feasible a cold dark matter detector based on nucleus recoil. Recent results on the metastability of very large granules also suggest that a SSG large area monopole detector may be feasible, if the theoretically conjectured detection principle (destruction of the superheated state by two injected flux quanta) is checked experimentally. We also consider the use of special crystal scintillators to detect Majorana fermions through inelastic scattering.

34862 (LAPP-TH–206-87) **Cosmions and Stars.** Salati, P.; Bouquet, A.; Kaplan, J. Grenoble-1 Univ., 74 - Annecy (France). Lab. de Physique des Particules. 1987. 9p. (CONF-8707174–: Rencontre on the hidden mass and the dark matter, Annecy, France, 8-10 Jul 1987). Order Number DE89781499/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

Hypothetical particles such as the heavy neutrino, the photino anti γ, or the sneutrino anti ν -generically called cosmions- may solve the so called missing mass problem. If they exist, the cosmions may close the Universe. In addition to their gravitational effect on cosmological scales, the cosmions may also be captured by stars and concentrate in their cores. Since cosmions are able to transport heat outside stellar cores much more efficiently than photons, they may seriously affect the thermodynamics of the inner layers of stars. We have done an exact calculation of the accretion rate of cosmions by main sequence stars and we have studied the suppression of their central convection. We concluded that central convection inside stars between 0.3 solar mass and 1 solar mass is broken in the presence of cosmions.

34863 (LAPP-TH–215-88) **Wimps and stellar structure.** Bouquet, A.; Kaplan, J.; Martin, F.; Salati, P. Grenoble-1 Univ., 74 - Annecy (France). Lab. de Physique des Particules. 1988. 4p. (CONF-8803113–: 8. Moriond astrophysics meeting on dark matter, Les Arcs, France, 6-13 Mar 1988). Order Number DE89781533/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

We present the results of an analytic approximation to compute the effects of WIMPs on stellar structures in a self-consistent way. We examine in particular the case of the Sun and of horizontal branch stars.

34864 (LA-UR–89-1593) **The magnetic topology of the plasmoid flux rope in a MHD simulation of magnetotail reconnection.** Birn, J.; Hesse, M. Los Alamos National Lab., NM (USA). 1989. 17p. Sponsored by DOE/ER;NASA. DOE Contract W-7405-ENG-36. (CONF-8903131–2: Chapman conference on the physics of magnetic flux ropes, Hamilton, Bermuda, 27-31 Mar 1989). Order Number DE89012621/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

On the basis of a three-dimensional MHD simulation we discuss the magnetic topology of a plasmoid that forms by a localized reconnection process in a magnetotail configuration including a net dawn-dusk magnetic field component B_{yN}. As a consequence of b_{yN}

≠ 0 the plasmid gets a helical flux rope structure rather than an isolated island or bubble structure. Initially all field lines of the plasmid flux rope remain connected with the Earth, while at later times a gradually increasing amount of flux tubes becomes separated, connecting to either the distant boundary or to the flank boundaries. In this stage topologically different flux tubes become tangled and wrapped around each other, consistent with predictions on the basis of ad-hoc plasmid models. 10 refs., 8 figs.

34865 (PB–89-139943/XAB) **Solar-Geophysical Data Number 531, November 1988. Part 1 (prompt reports). Data for October, September 1988, and late data.** Coffey, H.E.; McKinnon, J.A. National Geophysical Data Center, Boulder, CO (USA). Nov 1988. 150p. (SGD–531-PT-1). Available from NTIS, PC A07/MF A01.

See also Part 2, PB–89-139950, and PB–89-109904.

Contents include: detailed index for 1988: data for October 1988 (IUDS alert periods (advance and worldwide), solar-activity indices, solar flares, solar radio emission, Stanford mean solar magnetic field); data for september 1988 (solar-active regions, sudden ionospheric disturbances, solar radio spectral observations, cosmic-ray measurements by neutron monitor, geomagnetic indices, radio-propagation indices); late data (Pioneer XII interplanetary magnetic field magnitudes december 1987, cosmic-ray measurements by neutron monitor July-August 1988, radio-propagation indices August 1988).

34866 (RRK–88-33) **Cosmic microwave anisotropies and large scale velocity fields in isocurvature hot dark matter models.** Sugiyama, Naoshi; Sasaki, Misao; Tomita, Kenji. Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics. Nov 1988. 15p. Order Number DE89778050/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

We investigate the evolution of isocurvature density perturbations in a universe dominated by hot dark matter (HDM), and evaluate anisotropies in the cosmic microwave background and large scale peculiar velocity fields. We find isocurvature HDM models are more viable than adiabatic HDM models in that the former can account for relatively large velocity fields on large scales while keeping the cosmic microwave background anisotropies below the observational upper limits as compared to the latter. However isocurvature HDM models would still have difficulties if the actual velocity fields on scales > approx $50h^{-1}$Mpc were confirmed to be substantially greater than ~400km/sec.

34867 (RRK–88-35) **Stochastic approach to chaotic inflation and the distribution of universes.** Nambu, Yasusada; Sasaki, Misao. Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics. Nov 1988. 15p. Order Number DE89778051/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Using the Fokker-Planck equation derived from stochastic approach to inflation, we investigate the dynamics and global structure of the chaotic inflationary universe. We take full account of the difference in the physical volume of each horizon size region in the Fokker-Planck equation. We find that the modified Fokker-Planck equation admits a normalizable stationary solution, contrary to the original equation. We evaluate the approximate form of the solution and argue that it describes both the distribution of quantum universes out of which our universes was born and that of large classical (grow-up) universes like ours. In particular, for λphi^4-theory, the distribution of classical universes has a power-law spectrum. Thus there appears no characteristic scale and the distribution of classical universes has a fractal structure.

34868 (RRK–88-36) **Gravitational lens effect on anisotropies of cosmic microwave background.** Sasaki, Misao. Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics. Nov 1988. 10p. Order Number DE89778049/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

We discuss the general feature of gravitational lens effect on anisotropies of cosmic microwave background radiation. Contrary to previous studies, we find that small angle anisotropies can be enhanced if the characteristic angular scale associated with the gravitational lens effect is comparable to the correlation angle of the cosmic microwave anisotropy. That this conclusion is physically reasonable can be rather easily understood.

34869 (TRITA-EPP–88-04) **Astrophysics in a nutshell from the telescope to the sputnik.** Alfven, H.; Faelthammar, C.G. Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics. Mar 1988. 18p. Order Number DE89617764/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Progress in astrophysics - as well as in many other sciences - is not only due to new ideas but also to the introduction of new methods of observation. The 'Copernican revolution' was more due to the introduction of the telescope than to the heliocentric model which had been invented 2000 years earlier. Further, the decisive importance of electromagnetic effects in astrophysics originated from Langmuir's invention of the plasma probe and from Birkeland's terrella experiment and his observations of plasma in space (aurora). A similar revolution has now been introduced by space research which has made possible in situ measurements in cosmic plasmas and has opened the X-ray and γ-ray regions to observation. The result is a drastic revision of essential parts of astrophysics (including cosmology) leading to the 'Plasma Universe' model. (authors).

34870 (TRITA-EPP–88-07) **Has the universe an origin?.** Alfven, H. Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics. Jul 1988. 13p. Order Number DE89617765/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

In the cosmological discussion it has during the last few decades been taken for granted that the Lemaitre-Gamov cosmology - usually referred to as the Big Band is the only acceptable one. The Universe must have been created ex nihilo in a singular point. Criticism of the Big Bang hypothesis is usually answered by: And how do you create the Universe? Most people seem to be so ignorant of the history of science and philosophy that they do not remember that most scolars have considered the Universe to be 'ungenerated and indestructable'. The only exceptions seem to be some Christian theologicans in the first centuries AD and their school, to which Lemaitre and Gamov and their Big Bang hypothesis belongs. It is demonstrated that there are no observational facts which unquestionable speak in favour of the Big Bang hypothesis. The 'Sputnik revolution' makes it necessary to revise important parts of astrophysics, and is also fatal to the Big Bang. It seems necessary to turn back to the view of an 'ungenerated' (and indestructable) Universe.

34871 (UCRL–101129) **Use of the EGRET [Energetic Gamma-Ray Experiment Telescope] instrument in studies of the origin of the cosmic radiation.** Dermer, C.D. Lawrence Livermore National Lab., CA (USA). 19 May 1989. 7p. Sponsored by DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-8904216–4: Gamma ray observatory science workshop, Greenbelt, Maryland, USA, 10-12 Apr 1989). Order Number DE89013785/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The Energetic Gamma-Ray Telescope (EGRET) onboard the Gamma Ray Observatory will provide the first detailed map of the galaxy showing both intensity and spectral variations at >20 MeV gamma-ray energies. Possible reasons for gamma-ray spectral variations are considered under the hypothesis that point sources of cosmic rays exist. We show how the spectrum and intensity of cosmic rays in the vicinity of such objects can depend on propagation effects, injection conditions and model geometry in a number of special cases. 21 refs., 4 figs.

34872 **Limits on reheating in inflationary cosmology models.** Barr, S. (Department of Physics, Bartol Research Institute, University ofp Delaware, Newark, Delaware 19716(US)); Segre, G. *Physical Review Letters (USA),* 62(24): 2781-2784 (12 Jun 1989).

We show that the decay of a scalar particle into ordinary matter particles is restricted by the mass and by the vacuum expectation value of the scalar field. If this scalar field is responsible for inflation, difficulties with reheating the Universe may ensue. For the case of induced-gravity models, where the magnitude of the vacuum expectation value is of order the Planck mass, the scalar field decays predominantly into gravitons and adequate reheating does not occur in the usual slow rollover scenario. We also discuss the effect of the energy stored in the scalar-field oscillations.

34873 **Neutrino oscillations and uncertainty in the solar model.** Dearborn, D. S. (Institute of Geophysics and Planetary Physics, University of California, Lawrence Livermore National Laboratory, Livermore, California 94550(US)); Fuller, G. M. *Physical*

Review [Section] D: Particles and Fields (USA), 39(12): 3543-3548 (15 Jun 1989). DOE Contract W-7405-ENG-48.

The Mikheyev-Smirnov-Wolfenstein (MSW) resonant neutrino oscillationmechanism is investigated for the Sun using a detailed numerical solar modeland a modified version of the Parke-Walker technique for following the neutrinophases through the oscillation resonance. We present overall solar-neutrinospectra and the associated expected neutrino count rates for the^{37}Cl, ^{71}Ga, and Kamiokande detectors for rangesof masses and vacuum mixing angles for two neutrino species. We alsoinvestigate the effects of uncertainties in the solar model. In particular, weexamine the effect of opacity changes on the expected solar-neutrino spectrumand resulting parameter space for the MSW mechanism. We find that plausibleuncertainties in the standard solar model, and in particular the opacity,translate into significant expansion in the constraints on neutrino masses andvacuum mixing angles from neutrino experiments. It is shown, however, thatforthcoming results from the Kamiokande solar-neutrino experiment could putstringent constraints on even the expanded MSW parameter space.

34874 Formation of topological defects in phase transitions. Hodges, H. M. (Physics Department, The University of Chicago, Chicago, Illinois 60637(US)). *Physical Review [Section] D: Particles and Fields (USA),* 39(12): 3557-3567 (15 Jun 1989).

We argue, and find through numerical work, that the results of nondynamicalMonte Carlo computer simulations cannot be applied to describe the formation oftopological defects when the correlation length at the Ginzburg temperature issignificantly smaller than the horizon size, the case which was originallyconsidered. To test the current hypothesis that "infinite" strings atformation are essentially described by Brownian walks of size the correlationlength at the Ginzburg temperature, we examine equilibrated fields at theGinzburg temperature. We find that no "infinite" structure exists inequilibrium for reasonable definitions of the Ginzburg temperature, and thathorizons must be included in a proper treatment. A phase transition, fromsmall-scale to large-scale string or domain-wall structure, is found to occurvery close to the Ginzburg temperature, in agreement with recent work. We alsoinvestigate the formation process of domain walls and global strings throughthe breaking of initially ordered states. To mimic conditions in the earlyUniverse, cooling times are chosen so that horizons exist in our sample volumewhen topological structure formation occurs. The classical fields are evolvedin real time by the numerical solution of Langevin equations of motion on athree-dimensional spatial lattice. Our results indicate that it is possible formost of the string energy to be in small loops, rather than in long strings, atformation.

34875 Quantum probability distributions in the early Universe. IV. Stochastic dynamics in de Sitter space. Graziani, F. R. (School of Physics and Astronomy, University of Minnesota, Minneapolis, Minnesota 55455(US)). *Physical Review [Section] D: Particles and Fields (USA),* 39(12): 3630-3641 (15 Jun 1989).

Using the Smoluchowski equation, we investigate the stochastic evolution ofthe horizon-averaged or coarse-grained scalar field (inflaton) in a pure deSitter background. We clarify the effect quantum fluctuations have on theclassical dynamics of relaxation. We consider two types of nonlinear potentials[$V(\phi)=(1/2\gamma\phi^2+ 1) /4\ g\phi^4$ and $V(\phi)=-(1/2\lambda\phi^2+ 1) /4\ g\phi^4$] with inflaton probability distributions initially displaced from equilibrium. In the former case quantum fluctuations have only a minor effect on the classical inflaton dynamics. In the latter case the situation is different. Quantum fluctuations play a crucial part in the early-time behavior of the inflaton probability distribution. Using techniques borrowed from nonequilibrium statistical mechanics, we show how [for $V(\phi)=-(1/2\lambda\phi^2+ 1) /4\ g\phi^4$] macroscopic (classical) order originates from stochastic (quantum) initial conditions. We estimate the time scale at which this transition takes place. The work here extends and validates the conclusion of Guth and Pi that the long-time behavior of $f(\phi;t)$ can be described by a classical probability distribution.

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Refer also to citation(s) 34728, 34865

34876 (ACIESP–60(v.3), pp. 78-83) **Two interesting ionospheric phenomena over Brazilian Anomaly (South Atlantic Geomagnetic Anomaly).** Oyama, K.-I. (Institute of Space and Astronautical Science, Tokyo (Japan)); Abe, T. Academia de Ciencias do Estado de Sao Paulo, SP (Brazil). 1988. (CONF-8808156–: 6. Japan-Brazil symposium on science and technology, Sao Paulo, Brazil, 10-12 Aug 1988). In *Proceedings of the 6. Japan-Brazil Symposium on Science and Technology.* Order Number DE89612371/JAW. Available from NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS.

Two electron temperature events which take place over Brazilian Geomagnetic Anomaly; (1) Heating of thermal electrons which seems to occur quite often during night time. (2)heating of thermal electrons in plasma bubble, are reported.

34877 (ACIESP–60(v.3), pp. 205-208) **Energetic electron precipitation at the South Atlantic Magnetic Anomaly: a review.** Pinto Junior, O. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos, SP (Brazil)); Gonzalez, W.D. Academia de Ciencias do Estado de Sao Paulo, SP (Brazil). 1988. (CONF-8808156–: 6. Japan-Brazil symposium on science and technology, Sao Paulo, Brazil, 10-12 Aug 1988). In *Proceedings of the 6. Japan-Brazil Symposium on Science and Technology.* Order Number DE89612371/JAW. Available from NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS.

The status of knowledge concerning energetic electron precipitation at the South Atlantic Magnetic Anomaly (SAMA) is presented. The main purpose is to place recent results in context with the long standing problems about energetic electron precipitation at the SAMA region. A synopsis of results achieved in the last two decades related to several physical mechanisms responsible for precipitating energetic electrons are also presented. The major uncertainties in the understanding of the energetic electron precipitation at the SAMA include: (1) temporal and spatial precipitation changes from magnetically quiet to disturbed periods; and (2) the role of wave induced precipitation process.

34878 (ACIESP–60(v.3), pp. 209-212) **Measurements of VLF-particle interactions at the South Atlantic Magnetic Anomaly on board a Brazilian geophysical satellite.** Gonzalez, W.D. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos, SP (Brazil)); Pinto Junior, O.; Dutra, S.L.G.; Takahashi, H. Academia de Ciencias do Estado de Sao Paulo, SP (Brazil). 1988. (CONF-8808156–: 6. Japan-Brazil symposium on science and technology, Sao Paulo, Brazil, 10-12 Aug 1988). In *Proceedings of the 6. Japan-Brazil Symposium on Science and Technology.* Order Number DE89612371/JAW. Available from NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS.

A summary of the proposal for measurements of VLF wave-particle interactions, expected to occur at the South Atlantic magnetic anomaly, to be carried out on board a Brazilian geophysical satellite, will be presented. The expected domain of such interactions refers to electromagnetic VLF waves and to energetic-relativistic inner belt electrons, pitch angle diffusing into the atmosphere via cyclotron resonances. The detectors involve a triaxial search coil magnetometer and a surface barrier silicon telescope. A modified and preliminary version of this proposed experiment will be carried out on board long duration balloon flights, well before the beginning of the intended satellite measurements. For the ballon flights the particle detector will be replaced by an x-ray detector, which can also monitor parameters related to the electron precipitation.

34879 (ACIESP–60(v.3), pp. 253-257) **Investigation on the post-midnight formation of ionospheric bubbles.** Bonelli, E. (Rio Grande do Norte Univ., Natal (Brazil)); Medeiros, R.T.; Borba, G.L. Academia de Ciencias do Estado de Sao Paulo, SP (Brazil). 1988. (CONF-8808156–: 6. Japan-Brazil symposium on science and technology, Sao Paulo, Brazil, 10-12 Aug 1988). In *Proceedings of the 6. Japan-Brazil Symposium on Science and Technology.* Order Number DE89612371/JAW. Available from NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS.

The experimental techniques to investigate the formation of plasma density irregularities which occurs in the equatorial nighttime F-region are shown. (M.C.K.).

34880 (ACIESP–60(v.3), pp. 258-263) **Unusually large light-ion concentration in the ionospheric F-region at Arecibo during July 1986.** Sobral, J.H.A. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos, SP (Brazil)); Zamlutti, C.J.; Paula, E. de. Academia de Ciencias do Estado de Sao Paulo, SP (Brazil). 1988. (CONF-8808156–: 6. Japan-Brazil symposium on science and technology, Sao Paulo, Brazil, 10-12 Aug 1988). In *Proceedings of the 6. Japan-Brazil Symposium on Science and Technology.* Order Number DE89612371/JAW. Available from NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS.

Unusually large ionospheric F region light ion (H^+) concentrations have been detected during five nights of experiments that were carried out at the Arecibo Observatory. Concentrations many times larger than those predicted by ionospheric models have been observed. The obtained data during observations are presented.

34881 (ACIESP–60(v.3), pp. 264-270) **Overview on the equatorial electrojet theoretical grounds.** Zamlutti, C.J. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos, SP (Brazil)); Sobral, J.H.A.; Abdu, M.A. Academia de Ciencias do Estado de Sao Paulo, SP (Brazil). 1988. (CONF-8808156–: 6. Japan-Brazil symposium on science and technology, Sao Paulo, Brazil, 10-12 Aug 1988). In *Proceedings of the 6. Japan-Brazil Symposium on Science and Technology.* Order Number DE89612371/JAW. Available from NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS.

The grounds on which the equatorial electrojet theory is based are reexamined in a way as to suggest specific additional implementations in the existing electrodynamical modeling of this phenomena, making use of now existing improved computer processing speeds.

34882 (ACIESP–60(v.3), pp. 280-283) **Radiowave absorption measurements near geomagnetic anomaly region during a magnetic storm.** Rao, K.R. (Fundacao Universidade Regional de Blumenau, Santa Catarina (Brazil)); Pardo, P.M.R.; Trivedi, N.B.; Costa, J.M. da. Academia de Ciencias do Estado de Sao Paulo, SP (Brazil). 1988. (CONF-8808156–: 6. Japan-Brazil symposium on science and technology, Sao Paulo, Brazil, 10-12 Aug 1988). In *Proceedings of the 6. Japan-Brazil Symposium on Science and Technology.* Order Number DE89612371/JAW. Available from NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS.

The absorption of HF and MF radiowaves after a magnetic storm near geomagnetic anomaly is studied. (M.C.K.).

34883 (ACIESP–60(v.3), pp. 284-289) **Medium frequency radiowave absorption at sunrise and sunset times in the geomagnetic anomaly region.** Rao, K.R. (Fundacao Universidade Regional de Blumenau, Santa Catarina (Brazil)); Pardo, P.M.R. Academia de Ciencias do Estado de Sao Paulo, SP (Brazil). 1988. (CONF-8808156–: 6. Japan-Brazil symposium on science and technology, Sao Paulo, Brazil, 10-12 Aug 1988). In *Proceedings of the 6. Japan-Brazil Symposium on Science and Technology.* Order Number DE89612371/JAW. Available from NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS.

The ionosphere, at lower regions, behaves differently during sunrise and sunset times compared to the others day times. The E layer which is well formed during the day, almost disappears at these times and the effect of solar presence or absence at these altitudes is well evidenced immediately after sunrise or sunset. In the South Atlantic anomaly region, the energetic particle precipitaton complicates the phenomenon comprehension in these times. The carried out studies on presunrise and presunset absorption effects in the period from May to July, 1986, in order to understand the ionization processes in the lower ionospheric regions at these times. (M.C.K.).

34884 (ACIESP–60(v.3), pp. 296-300) **Upper atmosphere temperature measurements using an airglow photometer board a rocket.** Takahashi, H. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos, SP (Brazil)); Clemesha, B.R.; Batista, P.P.; Sahai, Y. Academia de Ciencias do Estado de Sao Paulo, SP (Brazil). 1988. (CONF-8808156–: 6. Japan-Brazil symposium on science and technology, Sao Paulo, Brazil, 10-12 Aug 1988). In *Proceedings of the 6. Japan-Brazil Symposium on Science and Technology.* Order Number DE89612371/JAW. Available from NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS.

One of the most useful techniques to observe neutral atmosphere temperature in the mesopause region, between 80 to 100 km, is to measure the molecular rotational temperature of the oxygen emission, O_2 (0,0) atmospheric band at 762.0 nm and the OH vibration-rotation band, for example OH (8,3) band at 732.0 nm. Ground based observations in these emissions have been carried out from various stations around the globe and their nocturnal and seasonal variations have been studied. Photometers on board a rocket, measuring in situ the emission spectra makes it possible to observe the height profile of the emissons and their rotational temperatures. The scientific background for carrying out these measurements from an equatorial and/or mid-latitude region and instrumentation to be used will be discussed.

34885 (IC–88/399) **Relationship between the current and the width of the POGO electrojet during the solstices.** Ozoemena, P.C.; Onwumechili, C.A. International Centre for Theoretical Physics, Trieste (Italy). Dec 1988. 20p. Order Number DE89619725/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A detailed study of the POGO data, obtained in the northern winter and summer seasons, all over the earth, has elucidated the relationship between the width and current intensity of equatorial electrojet. By employing regression and correlation analysis to these data, we find that, the width and current intensity of the equatorial electrojet are inversely correlated in such a manner that constriction in the width occurs whenever the current is highly intense. This therefore, demonstrates qualitatively that the solstitial electrojet is (a) wider in the morning hours when it is less intense (b) narrower around local noon when it is most intense and (c) broader again in the afternoon and evening hours when it is decaying. For this inverse relationship, we present an argument in favour of 'channelling' arising from differences in conductivities at various local times, winds and pinch effects among other factors. (author). 13 refs, 7 figs, 2 tabs.

34886 (IC–89/23) **Physics of the tropospheric radiopropagation.** Ajayi, G.O. International Centre for Theoretical Physics, Trieste (Italy). Feb 1989. 54p. Order Number DE89619726/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

The physics of the tropospheric radiopropagation is presented considering the atmospheric radio refractive index and taking into account the influence of precipitation and the attenuation due to the atmospheric gases. 35 refs, 20 figs, 3 tabs.

34887 (IC–89/36) **Upper ionosphere and magnetospheric-ionospheric coupling.** Manzano, J.R. International Centre for Theoretical Physics, Trieste (Italy). Feb 1989. 41p. Order Number DE89619727/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

After a presentation of the ionospheric physics and of the earth magnetosphere morphology, generation and dynamics, the magnetosphere-ionosphere coupling in quiet and perturbed conditions is discussed. Some summary information about other planetary magnetospheres, particularly Venus and Jupiter magnetospheres, are finally given. 41 refs, 24 figs.

34888 (INIS-mf–11450, pp. 243-247) **Gravitomagnetic explanation of cosmic phenomena without using computers. II. Streaming of plasma along field lines after an impact - even without any energy supply.** Woyk-Chvojkova, E. (Ceskoslovenska Akademie Ved, Prague (Czechoslovakia). Astronomicky Ustav). Ceskoslovenska Akademie Ved, Ondrejov (Czechoslovakia). Astronomicky Ustav. 1987. (CONF-8708269–: 10. European regional astronomy meeting of the IAU, Prague, Czechoslovakia, 24-29 Aug 1987). In *Astrophysics. Proceedings. Vol. 5.* Order Number DE89617701/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

A particle path formula was derived for charged particles spiralling in extended magnetic and gravity fields. In part I, a stationary dipole-like magnetic field was considered in which particles of the highest energies slowly but continuously diffuse upwards and fill the tops of highly extended field lines, while underescape charged particles diffuse downwards disengage from its top-trapped high-energy part. Under the impact which squeezes the magnetic tubes, field strength H decreases less than before and in this region even grows with altitude r. Consequently the pitch angle of all downwards spiralling particles increases less and vice versa: The plasma shifts

downwards, it streams downwards even without having gained any energy surplus. The bottom of the Van Allen belt shifts downwards and rises as soon as the impact has ceased. This explains the occurrence and disappearence of aurorae. When the H(r)-variation changes so that H=const is passed without gravity the magnetic mirror will immediately switch from the bottom on the top. In the gravity field a "hole effect" gradually reverses the path - between H=const and $H \sim r^{-1}$. Phenomena occurring apparently do not comply with some basic physical laws. (author). 6 figs.

34889 (TRITA-EPP–88-02) **Influence of conductivities consistent with field-aligned currents on high-latitude convection patterns.** Blomberg, L.G.; Marklund, G.T. Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics. Feb 1988. 19p. Order Number DE89617990/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The influence on the high-latitude ionospheric convection of conductivities associated with upward field-aligned currents is investigated. Potential patterns are calculated from a given distribution of field-aligned currents and a conductivity model. The resulting patterns are shown to be modified considerably by including a coupling term between the conductivity and the field-aligned current in the conductivity model. The clockwise rotation of the entire potential pattern is reduced when the conductivity enhancement coincides with the regions of upward field-aligned current. Also, the electric field within these regions turns out to be rather insensitive to change in the magnitude of the current. In regions of downward current or when the current-dependent conductivity is excluded there is on the other hand an almost linear relationship between current and electric field. Although the particles producing the conductivity enhancement may not be the same as those carrying the major part of the field-aligned current it is clear from observations that there is a positive correlation between upward current conductivity. Therefore, the simple relationship used in this study is believed to reflect rather well the principal features of the current-conductivity coupling, which is of im- portance to the modelling of ionospheric electrodynamics. (With 26 refs.) (authors).

34890 (TRITA-EPP–88-03) **Numerical model of ionospheric convection derived from field-aligned current and the corresponding conductivity.** Blomberg, L.G.; Marklund, G.T. Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics. Mar 1988. 21p. Order Number DE89617991/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A numerical model for the calculation of ionospheric convection patterns from given distributions of field-aligned current and ionospheric conductivity is described. The model includes a coupling between the conductivity and the field-aligned current, so that the conductivity peaks in regions of upward current, as usually observed by measurements. The model is very flexible in that the input distributions, the field-aligned current and the conductivity, have been parameterized in a convenient way. From the primary model output, namely the ionospheric electrostatic potential (or convection) in the corotating frame, a number of other quantities can be computed. These include: the potential in a Sun-fixed frame, the distribution of ionospheric (horizontal) current, and the Joule heating in the ionosphere. This model has been used together with input data inferred from satellite measurements to calculate the high-latitude potential distribution prevailing during a particular event. The model potential variation along the satellite orbit was found to be in excellent agreement with the measured electric field. The model has also been used to study some fundamental properties of the electrodynamics of the high-latitude ionosphere. The results of these different applications of the model have been published separately. (With 23 refs.) (authors).

34891 Ion conics and counterstreaming electrons generated by lower hybrid waves in the Earth's magnetosphere. Chang, T. (Massachusetts Institute of Technology Center for Space Research, Cambridge, MA (US)); Crew, G.B.; Retterer, J.M.; Jasperse, J.R. *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science (USA),* 17(2): 186-195 (Apr 1989).

The exotic phenomenon of energetic ion-conic and counterstreaming electron formation by lower hybrid waves along the discrete auroral field lines in the Earth's magnetosphere is considered. Mean particle calculations, plasma simulations, and analytical treatments of the acceleration processes are described.

34892 A new model for auroral breakup during substorms. Rothwell, P.L. (Air Force Geophysics Lab., Hanscom Air Force Base, Bedford, MA (US)); Block, L.P.; Falthammar, C.G.; Silevitch, M.B. *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science (USA),* 17(2): 150-157 (Apr 1989).

A model for substorm breakup is developed, based on the relaxation of stretched (closed) dipolar field lines, and the formation of an incipient current wedge within a single arc structure. It is argued that the establishment of a coupled current structure within a single arc leads to a quasi-stable system; i.e., the pre-breakup regime. Perturbation of the pre-breakup structure leads to an instability criterion. It is found, consistent with observations, that narrower auroral arcs at lower L shells undergo the most explosive poleward expansion. According to this model, the precise location at which breakup occurs depends on the O^+ density in the plasma sheet, the level of magnetic activity (K_p), and the intensity of the substorm westward electrojet in the ionosphere. An enhancement of any of these features will cause breakup to occur at lower L shells. Comparison of our model with the Heppner-Maynard polar-cap potential model indicates that breakup is restricted to the west of the Harang discontinuity consistent with recent observations from the Viking satellite.

34893 Numerical simulation of coastal flows when solar radiation is blocked by smoke. Molenkamp, C. R. (Atmospheric and Geophysical Sciences Division, Lawrence Livermore National Laboratory, University of California, Livermore, California(US)). *Journal of Applied Meteorology (USA),* 28(5): 361-381 (May 1989). DOE Contract W-7405-ENG-48.

Smoke from fires ignited in a large-scale nuclear exchange would greatly reduce the flux of solar radiation at the ground and lead to rapid cooling over continental regions. Because of its large heat capacity, the ocean would cool more slowly so that a thermal gradient would tend to develop at the continental coastlines. In order to investigate the hypothesis that these thermal gradients would lead to zones of persistent precipitation along the coastlines, a modified version of the Colorado State University Mesoscale Model has been used to simulate the evolution of atmospheric flows for both West and East coasts assuming a moderate westerly synoptic flow of 5 m s^{-1}. In both cases a layer of fog forms over the ground, effectively limiting the rate of cooling over land. This fog layer grows in height as the atmosphere aloft cools, forming a stratus cloud. Moisture from the ocean surface, mixed vertically into a radiatively cooled atmosphere, causes a cloud layer to form over the ocean as well. With both land and sea covered by clouds, there is no differential cooling, anomalous flow fields, or enhanced precipitation. These simulations also demonstrate the important role of moisture in moderating the initial rate of atmospheric cooling when solar radiation is blocked by smoke.

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Refer also to citation(s) 33924, 34086, 35231, 35326, 35327, 35328, 35340, 35341, 35407

34894 (AD-A–201328/2/XAB) **Photodissociation of triatomic hydrogen.** Cosby, P.; Helm, H. SRI International, Menlo Park, CA (USA). 18 Jul 1988. 5p. Available from NTIS, PC A02/MF A01.

Pub. in Physical Review Letters, Vol. 61, No. 3, 298-301(18 Jul 1988).

The unstable ground-state potential surface of triatomic hydrogen has served as prototype for the development of bimolecular reaction-rate theory, and is still largely territory only of theoretical chemistry. While the ground electronic state of H_3 is dissociative, electronically excited states of this molecule are tightly bound. These states are described in terms of a Rydberg electron bound by the field of the stable, triangular $H_3(+)$ core. The authors report the first observation of photodissociation of H_3. Predissociation of the optically prepared 3s(2) A1 and 3d(2)E states by the X(2)E' ground state is detected by monitoring of the production of vibrationally excited diatomic hydrogen molecules and H atoms. Product excitation is found to be highly dependent on H_3 electronic and nuclear configuration.

34895 (CONF-890586–1) **Resonantly enhanced multiphoton ionization of molecules.** Dehmer, P.M.; Dehmer, J.L.; Pratt, S.T.; Tomkins, F.S. Argonne National Lab., IL (USA). 1989. 5p. Sponsored by DOE Energy Research. DOE Contract W-31109-ENG-38. From Workshop on advanced laser technology for chemical measurement; Argonne, Illinois, USA; 9-11 May 1989. Order Number DE89014634/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We present a brief overview of recent work then concentrate on new studies of the mechanisms of energy and angular momentum exchange among electronic and nuclear modes during autoionization of quasi- bound Rydberg states of small molecules. 4 refs., 2 figs.

34896 (CONF-890703–7) **Beam emittance measurements of ORNL negative ion sources.** Tsai, C.C.; Akerman, M.A.; Becraft, W.R.; Dagenhart, W.K.; Haselton, H.H.; Schechter, D.E.; Stirling, W.L.; Whealton, J.H.; Donaghy, J.J. Oak Ridge National Lab., TN (USA). 1989. 16p. Sponsored by DOE Energy Research. DOE Contract AC05-84OR21400. From International conference on ion sources; Berkeley, California, USA; 9-15 Jul 1989. Order Number DE89014774/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The emittances of hydrogen and deuterium negative ion beams produced by volume ion sources have been measured in a transverse plane normal to the beam trajectory. The extraction voltage was varied from 10 to 40 kV, and the transverse magnetic field in the Penning discharges was varied from 0.1 to 0.2 T. Measurements were made on beams with current densities up to 60 mA/cm^2 at Oak Ridge National Laboratory with an emittance scanner originally developed at Los Alamos National Laboratory. The beam profile at the scanner can be used to improve the accuracy of the emittance measurements. Other factors affecting emittance measurements are discussed. This analysis may be applicable to other ion sources. 6 figs.

34897 (DOE/ER/13243–5) **Multilevel relaxation phenomena and population trapping: [Progress report], July 1, 1988–June 30, 1989.** Saint John Fisher Coll., Rochester, NY (USA). Apr 1989. 5p. Sponsored by DOE Energy Research. DOE Contract FG02-84ER13243. Order Number DE89013114/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This report summarizes the new results obtained in the past nine months from July 1, 1988, and the research work in progress. Our work deals with various aspects of multiphoton absorptions and radiations when a multilevel quantum system interacts with an intense laser field. We shall report in particular some exciting new developments on what we called the "counter-intuitive" way of exciting a three-level system, and a new theoretical prediction giving the conditions for lossless propagation of simultaneous solitary optical pulses through an atomic medium. 12 refs.

34898 (DOE/ER/13394–4) **Studies of autoionizing states relevant to dielectronic recombination: Progress report, July 1, 1988–April 1, 1989.** Gallagher, T.F. Virginia Univ., Charlottesville, VA (USA). Dept. of Physics. Apr 1989. 4p. Sponsored by DOE Energy Research. DOE Contract FG05-85ER13394. Order Number DE89013022/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

During the period July 1, 1988 to April 1, 1989 we have been working on four projects. We have completed an analysis of autoionization rates of Ba 6pnk states in time varying microwave fields, carried out experiments on the Ba 6pnf states, analyzed our spectra of the Ba 5dnd states, and begun the study of the Mg 3pnl states. These projects are described in this paper.

34899 (DOE/NV/10571–T2) **Measurement of the time-dependent distribution of ionization states in an argon plasma from a Mach-10 jet: Final report.** Filbert, P.C.; Fisher, T.R.; Kohler, D.; Perez, J.D.; Walton, R.A.; Dahlbacka, G. Lockheed Missiles and Space Co., Inc., Palo Alto, CA (USA). Research and Development Div. 28 Sep 1988. 49p. Sponsored by DOE Defense Programs. DOE Contract AC08-86NV10571. Order Number DE89014699/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

Results from experiments designed to measure the time-dependent distribution of ionization states in an argon plasma produced by laser irradiation of a high-Mach-number gas jet are presented. The gas valve/nozzle target system was designed for nominal Mach-10 performance and produced a jet of neutral gas several centimeters long from a nozzle exit of 1.5 mm diameter. The jet was irradiated at a position having an approximate atomic density of 1 x 10^{18}/cm^3 by 500 J of 351-nm laser light with a pulse width of 600 ps at the NLUF's OMEGA laser facility. It was found necessary to pre-ionize the gas in order to couple-in sufficient laser energy to produce a plasma. An argon plasma was then created that was dominated by charge states of Ar VIII through Ar XI. Comparison with a theoretical model which solved the time-dependent rate equations indicates that a plasma temperature of approximately 70 eV was achieved. A subsequent development effort carried out at the Lockheed Palo Alto Research Laboratory (LPARL) to improve the gas jet target system is also described. This work indicated that by increasing the pressure in the valve by a factor of 5 increased the coupling to the laser and produced significantly larger signals and higher plasma temperatures. 7 refs., 21 figs., 1 tab.

34900 (GANIL-P–88-05) **Ambiguities in the estimate of hard photon production in intermediate energy nucleus-nucleus collisions.** Bonasera, A.; Gregoire, C. Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France). 1988. 24p. Order Number DE89781541/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

We point out some ambiguities in numerical simulations of intermediate energy heavy ion collisions, as far as hard photon production is concerned. This emission process involves edges of available phase space; therefore it is quite sensitive to the particular approximate solution of the Landau-Vlasov (or VUU, BUU) equation which is considered for simulating the reaction. We have analyzed convergency of solutions as a function of the numerical accuracy defined by the number of test-pseudoparticles, the time step and the approximations for estimating the collision integral. We show also what is the role of the Coulomb and mean field-interaction and of the nuclear surface upon the hard photon component of the gamma spectra. A comparison with some available experimental data shows that the gamma yields calculated from our approximate solutions are smaller than the data for $E_\gamma > 100$ MeV.

34901 (GANIL-T–87-03) **Impact Parameter Dependent light Particle Correlations for ^{40}Ar induced reactions on ^{197}Au at E/A=60 MeV.** Kyanowski, A. Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France). May 1987. 107p. Order Number DE89781504/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

The determination of the space-time extent of a particle-emitting system with the help of two-particle correlations is based on the Hanbury-Brown and Twiss effect and its application to nuclear physics for protons or composite charged particles. On the basis of these models, light charged particle correlations at small relative momentum were measured for ^{40}Ar induced reactions on ^{197}Au at E/A=60MeV. The temperature of the emitting system was determined from the population ratios of particle-unbound states of composite systems. The space-time extent deduced from the d-α correlation function is 5.8 fm, which is larger than the root mean square radius of the composite system of all incoming nucleons at normal nuclear density if one assumes a negligeable lifetime of the system. Simulation indicates a broad distribution of the observed multiplicity over the different impact parameters, but the extreme cases of peripheral and central collisions can be separated. Peripheral collisions give rise to enhanced correlations, whereas the correlation function is strongly reduced for central collisions. Supposing that the spatial extent is independent of the impact parameter (except for very peripheral collisions) the observed variation of the correlation function could indicate a variation of the emission time for light particles rather than a spatial evolution. The temperature, determined equally after an event-type selection with the observed multiplicity, shows no variation with the impact parameter. This could indicate that a limiting temperature is reached at a value at which the emission of particles is faster than the temporal development of the temperature.

34902 (IC–88/227) **On superfluorescent generation of coherent radiation in a paramagnet.** Turaev, M.T.; Shumovsky, A.S. International Centre for Theoretical Physics, Trieste (Italy). Aug

1988. 12p. Order Number DE89618514/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

An exact definition is given of a superradiation intensity for a free system and for a system in cavity. The superradiant generation of the Zeeman transitions in proton paramagnet is described. (author). 7 refs, 2 figs.

34903 (IC–88/425) **Resonance fluorescence of atom in a strong magnetic field.** Peng Jinsheng. International Centre for Theoretical Physics, Trieste (Italy). Dec 1988. 11p. Order Number DE89617587/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A theory of resonance fluorescence of atom in a strong magnetic field is presented. A general expression for resonance fluorescence distribution is obtained, and the relation between the intensity of magnetic field and the fluorescence spectra is also analyzed. (author). 13 refs, 2 figs.

34904 (INIS-BR–1483, pp. 35) **Optical transitions in undoped quantum wells under in-plane magnetic fields.** Gomes, V.M.S. (Sao Paulo Univ., SP (Brazil). Inst. de Fisica); Leite, J.R. Minas Gerais Univ., Belo Horizonte (Brazil). Dept. de Fisica. 1989. (CONF-8901126–: 4. Brazilian school of semiconductor physics, Belo Horizonte, Brazil, 23 Jan - 3 feb 1989). In *Proceedings of the 4. Brazilian School of Semiconductor Physics.* Order Number DE89612194/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

EXCITONS/optical properties; EXCITONS/quantum electronics; QUANTUM ELECTRONICS/band theory; QUANTUM ELECTRONICS/magnetic fields; BINDING ENERGY; EXCITONS; NUMERICAL SOLUTION

34905 (INIS-BR–1483, pp. 66) **Effect of compensation in the energy of an electron bound to an impurity in a quantum well.** Colchesqui, B.C.F. (Sao Paulo Univ., SP (Brazil). Inst. de Fisica); Emmel, P.D.; Andrada e Silva, E.A. de; Cunha Lima, I.C. da. Minas Gerais Univ., Belo Horizonte (Brazil). Dept. de Fisica. 1989. (CONF-8901126–: 4. Brazilian school of semiconductor physics, Belo Horizonte, Brazil, 23 Jan - 3 feb 1989). In *Proceedings of the 4. Brazilian School of Semiconductor Physics.* Order Number DE89612194/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

IMPURITIES/binding energy; IMPURITIES/quantum electronics; POTENTIALS/impurities; POTENTIALS/quantum electronics; BOUND STATE; COMPARATIVE EVALUATIONS; ELECTRONS; IMPURITIES; POTENTIALS

34906 (LA-UR–89-1876) **H° temperature and density measurements in a Penning surface-plasma H^{minus} ion source.** Smith, H.V. Jr.; Allison, P.; Pitcher, E.J.; Stevens, R.R. Jr.; Worth, G.T.; Stutzin, G.C.; Young, A.T.; Schlachter, A.S.; Leung, K.N.; Kunkel, W.B. Los Alamos National Lab., NM (USA). 1989. 17p. Sponsored by DOD;DOE/ER. DOE Contract W-7405-ENG-36;AC03-76SF00098. (CONF-890703–1: International conference on ion sources, Berkeley, California, USA, 9-15 Jul 1989). Order Number DE89013463/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Using vacuum ultraviolet laser-absorption spectroscopy, the H° density and temperature are measured as a function of discharge current and H_2-gas flow in both the plasma column and the drift region between the plasma column and the emitter in the 4X source. For typical source operating parameters, the atom temperature is 1.5 eV in the plasma column and 0.6 eV in the drift region; the atom density, 7×10^{14} cm^{-3} in the plasma column and 4×10^{14} cm^{-3} in the drift region. Separate measurements give 2% for the ratio of H_2 molecules in the first vibrational level to the total H_2 density. 8 refs., 6 figs., 1 tab.

34907 (LBL–25423) **The atomic physics facility at the LBL ECR Source.** Clark, D.J.; Lyneis, C.M.; Prior, M.H.; Stokstad, R.G.; Chantrenne, S.; Egan, P.O. Lawrence Berkeley Lab., CA (USA). Apr 1989. 8p. Sponsored by DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-881151–63: International conference on the application of accelerators in research and industry, Denton, Texas, USA, 7-9 Nov 1988). Order Number DE89012976/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A low energy beam line facility for atomic and surface physics research has been added to the injection line of the ECR source at the LBL 88-Inch Cyclotron. Beams throughout the periodic table can be delivered to 3 beam line stations at energies up to 15 Q keV. Experiments using this facility include forbidden line emission from the ion beam, ion-atom collisions, merged electron-ion beams and sputtering by highly charged ions. 9 refs., 4 figs.

34908 (LBL–26259) **A preliminary report on x-ray photoabsorption coefficients and atomic scattering factors for 92 elements in the 10–10,000 eV region.** Henke, B.L.; Davis, J.C.; Gullikson, E.M.; Perera, R.C.C. Lawrence Berkeley Lab., CA (USA). Nov 1988. 373p. Sponsored by DOD;DOE/ER. DOE Contract AC03-76SF00098. F49620-87-K-0001. Order Number DE89013392/JAW. Available from NTIS, PC A14/MF A01 - OSTI; GPO Dep.

Based on currently available photoabsorption measurements and recent theoretical calculations by Doolen and Liberman, a revised best-fit determination of the photoabsorption cross sections is presented here for the elements Z = 1 to Z = 92 in the 10–10,000 eV range. The photoabsorption data used include those described in the Lockheed and DOE listings of research abstracts for the past ten years and those which have been recently added to the comprehensive NBS Measured data Base. The best-fit curves are compared with both the compilation of measurements and the calculations by Doolen and Liberman. Using the photoabsorption curves, the atomic scattering factors have been calculated for the energy range 50–10,000 eV and are also presented in this report.

34909 (LBL–26900) **Multiple-electron processes in fast ion-atom collisions.** Schlachter, A.S. Lawrence Berkeley Lab., CA (USA). Mar 1989. 29p. Sponsored by DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-890387–6: Workshop on highly charged ions: new physics and advanced techniques, Berkeley, California, USA, 13-15 Mar 1989). Order Number DE89012982/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Research in atomic physics at the Lawrence Berkeley Laboratory Super-HILAC and Bevalac accelerators on multiple-electron processes in fast ion-atom collisions is described. Experiments have studied various aspects of the charge-transfer, ionization, and excitation processes. Examples of processes in which electron correlation plays a role are resonant transfer and excitation and Auger-electron emission. Processes in which electron behavior can generally be described as uncorrelated include ionization and charge transfer in high-energy ion-atom collisions. A variety of experiments and results for energies from 1 MeV/u to 420 MeV/u are presented. 20 refs., 15 figs.

34910 (LYCEN–87-47) **Studies of non-nuclear physics at Ganil.** Remillieux, J. Lyon-1 Univ., 69 - Villeurbanne (France). Inst. de Physique Nucleaire. Oct 1987. 14p. (CONF-8710159–: 12. international conference on atomic collisions in solids, Okayama, Japan, 12-16 Oct 1987). Order Number DE89781495/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The experimental programs at GANIL using GeV heavy ions to investigate problems in solid state physics, atomic physics, and channeling are reviewed. There are: (1) The mechanism of defect creation by electronic excitation which has been studied in different classes of materials; non linear effects have been observed and structural phase transformations are shown to happen above a given electronic stopping power threshold. (2) High resolution spectroscopy of hydrogen- and helium- like ions which has been made to test QED and relativistic corrections in heavy atomic systems; the study of high energy collisions has also been performed, excitation mechanisms are observed to be different in gas and solid targets. (3) Channeling of heavy ions which allows the detailed study of radiative electron capture in solids.

34911 (ORNL/FTR–3265) **[First international symposium on Swift Heavy Ions in Matter (SHIM '89), Caen, France, and visits to Villigen, Zurich, and Geneva, Switzerland, May 8–19, 1989]: Foreign trip report.** Vane, C.R. Oak Ridge National Lab., TN (USA). 1 Jun 1989. 7p. Sponsored by DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89014180/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The traveler visited the Paul Scherrer Institute in Villigen, located outside Zurich, Switzerland, May 8, 1989, and presented an

informal seminar on high-resolution x-ray spectroscopy in heavy ion-atom collisions. He visited the EN tandem accelerator facility at ETH-Honngerberg in Zurich, Switzerland, on May 9, 1989, and presented a colloquium on x rays emitted by heavy ions in crystals. The traveler then visited CERN in Geneva, Switzerland, May 11–12, 1989, where discussions were carried out with CERN staff and others on ORNL proposed experiments, and especially on equipment requirements for these measurements. He then traveled to Caen, France, to attend the First Symposium on Swift Heavy Ions in Matter (SHIM'89), May 16–19, 1989, where he presented a paper on "Radiative Electron Capture by Bare- and One-Electron Ions Channeled in Silicon Crystals."

34912 (RISO-M–2740) **PATFIT-88. A data-processing system for positron annihilation spectra on mainframe and personal computers.** Kirkegaard, P.; Pedersen, N.J.; Eldrup, M. Risoe National Lab., Roskilde (Denmark). Feb 1989. 131p. Order Number DE89617595/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

A data processing system has been developed for analyzing positron annihilation lifetime and angular correlation spectra on mainframe and Personal Computers (PCs). The system is based on the PATFIT programs previously developed for use on mainframe computers. It consists of the three fitting programs POSITRONFIT, RESOLUTION and ACARFIT and three associated programs for easy editing of the input data to the fitting programs, as well as a graphics program for the display of measured and fitted spectra. They can be used directly on any IBM-compatible PC. The PATFIT-88 software is available from Risoe National Laboratory. (author) 5 ills., 46 refs.

34913 (UCRL–101134) **Molecules in intense laser fields.** Dixit, S.N.; McKoy, V. Lawrence Livermore National Lab., CA (USA). May 1989. 5p. Sponsored by DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-8810376–1: NATO advanced study institute on atoms in strong fields, Kos, Greece, 9-21 Oct 1988). Order Number DE89013807/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

In this paper, we will present some thoughts on the dynamics of interaction of molecules with intense laser fields. We will discuss the possible role of dissociation and autoionization in influencing the overall REMPI dynamics. Our arguments are of a speculative and qualitative nature and the hope is to stimulate the reader in the complex issues related to the intense field molecule interaction. It is hoped that carefully controlled experiments and new developments in theoretical techniques will help unravel the underlying details of the REMPI dynamics. 19 refs.

34914 Projection-operator approach to the unified treatment of radiative and dielectronic recombination. Haan, S. L. (Department of Physics, Calvin College, Grand Rapids, Michigan 49506(US)); Jacobs, V. L. *Physical Review [Section] A: General Physics (USA),* 40(1): 80-94 (1 Jul 1989).

A formalism that is based on projection operators is employed to obtain ageneral recipe for constructing matrix elements of the transition or *T*operator for electron-ion photorecombination processes in model systemsfeaturing a limited number of discrete states and continua. Theprojection-operator formalism allows for a natural separation of the totaltransition operator into a direct, or radiative recombination, contribution anda resonance, or dielectronic recombination contribution. Implementation of thegeneral recipe is discussed, and expressions for matrix elements of neededpropagators in the combined Hilbert space of electron and photon continua arederived for model systems in which one makes the pole approximation on thephoton continua, but not on the electron continua. The simplifications thatoccur when the pole approximation is made on all continua are presented.Finally, the recipe is employed to describe photorecombination for two modelsystems that feature an isolated autoionizing state. One model includes anarbitrary number of possible final-state photon continua, and the second modelincludes an arbitrary number of possible final-state electron continua. For theformer model, it is shown how the various terms entering into the expressionfor the recombination transition amplitude can be obtained from a perturbationseries and interpreted in terms of Feynman-like diagrams.

34915 Theoretical Penning electron-energy distributions for alkali-metal atoms: He(2 ^{1,3}S) collisions with sodium and potassium. Padial, N. T. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545(US)); Cohen, J. S.; Martin, R. L.; Lane, N. F. *Physical Review [Section] A: General Physics (USA),* 40(1): 117-124 (1 Jul 1989).

Penning electron-energy distributions are calculated for collisions ofHe(2 ^{1}S) and He(2 ^{3}S) with sodium and potassiumatoms. The formulation is in terms of quantum-mechanical wave functions, whichare determined using previously published complex potentials for the initialstates and available experimental or presently calculated Hartree-Fockpotential curves for the final state. Sensitivities to these potentials aretested. The mechanisms for the observed energy structure are analyzed, and theeffects of experimental finite energy resolution and collisional velocityspread on the structure are shown.

34916 Measurement of *K* x rays from muonic helium formed in a low-density target in an intense pulsed muon beam. Blaer, A. (Nevis Laboratories, Department of Physics, Columbia University, Irvington, New York 10533(US)); French, J.; Sachs, A. M.; May, M.; Zavattini, E. *Physical Review [Section] A: General Physics (USA),* 40(1): 158-162 (1 Jul 1989). DOE Contract AC02-76CH00016.

An experiment was constructed to measure the contribution of vacuumpolarization [in quantum electrodynamics (QED)] to the 3*d*-3*p* energydifference in muonic helium. Major features of the experimental apparatusincluded design and construction of a pulsed beam of stopping muons with thehighest instantaneous intensity available, a laser system producing multijoulepulses from doubly isotopic CO_2 gas, a cavity to trap the laserlight in 3 atm of helium, and Si(Li) detectors to measure the helium x rays.The number of stimulated x rays accumulated was not sufficient to permit astatistically significant QED measurement, but the results demonstrate thefeasibility of laser spectroscopy in a pulsed muon beam. The intensities ofseparate *K* x-ray lines in muonic helium were measured at 1 and 3 atm forcomparison with recent theories of pressure effects on the muon cascade.

34917 Auger-electron emission from collisionally excited 3.4-MeV/u Na-like Ti ions. Schneider, D. (Department of Physics, V-Division, University of California, Lawrence Livermore National Laboratory, Livermore, California 94550(US)); Beiersdorfer, P.; Chen, M.; Walling, R.; Molitoris, J. D.; De Witt, D. *Physical Review [Section] A: General Physics (USA),* 40(1): 181-186 (1 Jul 1989).

L Auger-electron emission following selective excitation ofautoionizing states in 3.4-MeV/u Na-like Ti ions by He and Ar has beeninvestigated using the technique of 0° electron spectroscopy. The electronemission has been compared to model spectra based on oscillator strengths,transition energies, and transition rates from multiconfigurational Dirac-Fockcalculations as well as on collision strengths from the literature. It wasfound that monopole, dipole, and quadrupole excitation of Auger states with anexcited-state configuration $2p^5 3snl$ (n=3,4)causes the dominating structure in the spectrum where He was used as anexciter.

34918 Jellium-model calculation for monomer and dimer decays of some potassium clusters. Saito, Susumu (California Univ., Los Angeles (USA). Dept. of Physics); Cohen, M.L. *Zeitschrift fuer Physik D: Atoms, Molecules and Clusters (F.R. Germany),* 12(1-4): 205-208 (Jun 1989). DOE Contract AC03-76SF00098. (CONF-8807155–: 4. international symposium on small particles and inorganic clusters (ISSPIC-4), Aix-en-Province, France, 5-9 Jul 1988).

We have studied several decay processes of potassium clusters and found that a dimer-decay mechanism can explain the observed lowest abundance of K_{10} in the K_n mass spectra. Total-energy curves for decay processes are calculated using a jellium-background model for positive-ion cores and the local-spin-density-functional approximation for valence electrons. The energy-barrier height for a dimer decay of K_{10} from the energy-minimum point is found to be 0.18 eV, which is a reasonable magnitude for the decay to take place thermally in the experiment. The monomer decay of K_9 and the dimer decay of K_{11}, which are expected to be the most favorable decays of K_9 and K_{11}, are found to have high barriers. Monomer and dimer decays of K_8 are also studied and the monomer decay is found to be more favorable, in accord with the high-nozzle-temperature mass spectrum.

34919 A comprehensive table of atomic fluorescence detection limits and experimental conditions. Smith, B. W. (Department of Chemistry, University of Florida, Gainesville, Florida 32611(US)); Glick, M. R.; Spears, K. N.; Winefordner, J. D. *Applied Spectroscopy (USA)*, 43(3): 376-414 (Mar 1989).

A comprehensive table of atomic fluorescence spectrometry results has been compiled and arranged by element. Data tabulated include excitation and fluorescence wavelengths, atom reservoir, excitation source, limits of detection, and comments concerning experimental peculiarities and types of samples analyzed.

34920 Laser-induced fluorescence spectroscopy of NCS in a free jet expansion. Northrup, F. J. (Department of Chemistry, Brookhaven National Laboratory, Upton, New York 11973(US)); Sears, T. J. *Journal of Chemical Physics (USA)*, 91(2): 762-774 (15 Jul 1989). DOE Contract AC02-76CH00016.

Laser-induced fluorescence excitation spectra have been recorded for many vibronic transitions of the $A(^2\Pi)$–$X(^2\Pi)$ and $B(^2\Sigma+)$–$X(^2\Pi)$ systems of NCS under supersonic free jet expansion conditions. New assignments have been made for many of these bands and several of the assignments from previous work have been revised. Vibronic energies have been determined for levels involving excitation of all three vibrational modes in the ground electronic state and both excited electronic states. A detailed rotational and vibrational analysis has been carried out for levels involving excitations of the two stretching modes and the many rotational and potential function constants have been determined for the *A* and *X* states. The variation of the spin–orbit constant with vibrational level has also been investigated. Results of this paper provide the ground work for a detailed analysis of the Renner–Teller effect in the bending vibrational mode of this radical for both the $X^2(\Pi)$ and $A(^2\Pi)$ states to appear in a forthcoming paper. They also provide a spectroscopic database for future dynamical and kinetics studies of processes involving this radical.

34921 State-to-state integral cross sections for the inelastic scattering of CH($X\ ^2\Pi$)+He: Rotational rainbow and orbital alignment. Macdonald, R. G. (Gas Phase Chemical Dynamics Group, Chemistry Division, Argonne National Laboratory, Argonne, Illinois 60439(US)); Liu, K. *Journal of Chemical Physics (USA)*, 91(2): 821-838 (15 Jul 1989). DOE Contract W-31-109-ENG-38.

The state-to-state integral cross sections for the inelastic scattering of CH($X\ ^2\Pi$) with He were measured in a newly constructed crossed molecular beam machine. Use of laser-induced fluorescence in an unconventional flux mode of detection provided single fine-structure state specific detection of the products. Two types of measurements were performed to further our understanding of the collision dynamics of open shell systems: (1) the product state distribution at a fixed and well-defined collision energy and (2) the dependence on collision energy of product state-resolved cross sections. A qualitative understanding of the collision dynamics can be obtained by properly factoring out features dependent on the fine-structure states, i.e., effects involving individual Λ-doublet states and features dependent on the rotational level alone, i.e., effects remaining after summing over all four fine-structure states associated with a given rotational quantum number. As for the fine-structure effects, a preferential population of product Λ-doublet states with reflection symmetry $\Pi(A'')$ was observed. The physical origin of this observed electronic orbital alignment can be attributed to a quantum interference phenomenon, as detailed in the accompanying paper. At the rotational level, the dominance of rotational rainbow scattering is unambiguously identified from both the existence of dynamical thresholds and a strong correlation between rotational level distributions at fixed translational energy and level specific excitation functions. These effects combined with other experimental observations lead us to visualize the CH+He scattering dynamics in a novel fashion. The collision can be regarded as a series of approximately independent sequential events each mediated by different regions of the interaction potential during the course of the whole encounter.

34922 The inelastic scattering of $^2\Pi$ [case (b)] molecules and an understanding of the differing Λ doublet propensities for molecules of π vs π^3 orbital occupancy. Dagdigian, P. J. (Department of Chemistry, The Johns Hopkins University, Baltimore, Maryland 21218(US)); Alexander, M. H.; Liu, K. *Journal of Chemical Physics (USA)*, 91(2): 839-848 (15 Jul 1989).

The quantum formalism for the scattering of a diatomic molecule in a $^2\Pi$ electronic state which is well described by Hund's case (b) limit is investigated here. For a particular $JF_i \rightarrow J'F'_1$ transition, quantum interference effects will lead to preferential population of one of the final state Λ doublet levels. The nonstatistical population of final state Λ doublet levels arises from an interference between terms in the expansion of the two electrostatic potential energy surfaces, of A' and A'' reflection symmetry, which describe the interaction between a molecule in a Π electronic state and a closed-shell partner. The particular Λ doublet level preferred is opposite for molecules of π^1 vs π^3 electron occupancy. The physical origin of this reversal in the Λ doublet propensity is a direct reflection of the fact that for the former the A' potential surface is more repulsive since the sole π electron lies in the triatomic plane in this case, whereas for molecules of π^3 electron occupancy the A' surface is less repulsive than the A'' surface since for the A' surface only one of the three π electrons lies in the triatomic plane. The magnitude of these Λ doublet propensities is illustrated by calculated cross sections for the CH($X\ ^2\Pi$)–He system using the *ab initio* potential energy surfaces calculated by the Argonne theoretical group, and these cross sections are compared to those of the crossed molecular study of Liu and Macdonald [J. Chem. Phys. **91**, xxxx (1989)]. A similar analysis is carried out for collisions of a molecule of π^3 electron occupancy and is illustrated by inelastic collisions of OH($X^2\Pi$).

34923 New oxide cathode assembly for a duoplasmatron. Massoletti, D. J. (Lawrence Livermore National Laboratory, Livermore, California 94550(US)). *Review of Scientific Instruments (USA)*, 60(5): 960-961 (May 1989). DOE Contract W-7405-ENG-48.

An oxide cathode assembly has been designed for long life and serviceability in a duoplasmatron ion source using deuterium gas; with cathode lifetimes on the order of 250 h with an arc discharge power of 5 kW.

34924 The emittance characteristics of a gallium liquid-metal ion source. Alton, G. D. (Oak Ridge National Laboratory, P. O. Box 2008, Oak Ridge, Tennessee 37831-6368(US)); Read, P. M. *Journal of Applied Physics (USA)*, 66(3): 1018-1022 (1 Aug 1989). DOE Contract AC05-84OR21400.

First measurements have been made of the emittances of momentum-analyzed $^{69}Ga^+$ ion beams extracted from a liquid-metal ion source. Comparisons of the emittances of beams extracted and postaccelerated with conical and planar geometry electrode systems indicate that the planar geometry system is less aberrant. Space-charge effects and other sources of energy spread lead to increases in the emittances in the energy-dispersion plane of the momentum-analysis system (*x* direction) over their *y*-direction counterparts. The energy spread increases rapidly with beam intensity. Brief descriptions are provided of the experimental apparatus and procedures used during these investigations, and emittance and brightness data measured for ion beams accelerated by the two electrode systems are presented.

34925 *Ab initio* calculation of the hyperfine coupling constants in B_2. Carmichael, I. (Radiation Laboratory, University of Notre Dame, Notre Dame, Indiana 46556(US)). *Journal of Chemical Physics (USA)*, 91(2): 1072-1078 (15 Jul 1989).

Hyperfine coupling constants for the ground electronic state of the B_2 molecule, $[^3\Sigma^-_g]$, are computed using correlation procedures based on spin-unrestricted wave functions. Two distinct methods have been employed. Firstly, a variational configuration mixing approach with all configurations arising from single and double replacements in the reference wave function has been augmented by an approximate size-consistency correction. Secondly, a many-body perturbation theory procedure based on the coupled–cluster expansion with infinite-order doubles has been approximately corrected for single and triple excitations through fourth order. Both isotropic and dipolar coupling constants have been obtained as expectation values over the appropriate wave functions for the unrestricted Hartree–Fock (UHF) and the variational configuration-interaction (CI) methods. The anisotropic coupling is already satisfactorily accounted for at the UHF level, while even with the approximate correction for the effect of higher excitations, the variational CI approach still underestimates the isotropic splitting by a factor of 2. The origin of this deficiency is traced using the other correlation

method in which the isotropic coupling is derived from the normalized spin density at the nucleus, obtained by finite-field perturbation theory. The effect of the inclusion of triple excitations from the UHF wave function is seen to contribute about one third of the observed value. Such excitations are not accounted for in the size-consistency corrected variational CI approach. This conclusion is confirmed by a similar finding in a full fourth-order Moller–Plesset (MP) calculation.

34926 Theory for first super-strong liquid-crystalline polymers. Dowell, F. (Theoretical Division, Los Alamos National Laboratory, University of California, Los Alamos, New Mexico 87545(US)). *Journal of Chemical Physics (USA)*, 91(2): 1316-1325 (15 Jul 1989). DOE Contract W-7405-ENG-36.

This paper presents a unique microscopic molecular theory for liquid-crystalline polymers (LCPs). In the following paper, this theory is used to predict and design (atom by atom, bond by bond) the first super-strong (SS) LCPs. This paper here compares the results calculated from this theory with available experimental data for different kinds of existing LCPs. The theory presented in this paper treats backbone LCPs, side-chain LCPs, combined LCPs, and low-molecular-weight LC materials in the isotropic liquid phase, in the nematic LC phase, and in multiple smectic-A LC phases. In this paper here, we see that results calculated using this theory are in *very* good agreement with available experimental data for various existing LCPs. Specifically, the relative deviations between the theoretical and experimental results presented here vary from 0% to less than 6.2%. This agreement gives us considerable confidence in the use of this theory in the following paper to predict and design the first SS LCPs.

34927 Prediction and design of first super-strong liquid-crystalline polymers. Dowell, F. (Theoretical Division, Los Alamos National Laboratory, University of California, Los Alamos, New Mexico 87545(US)). *Journal of Chemical Physics (USA)*, 91(2): 1326-1338 (15 Jul 1989). DOE Contract W-7405-ENG-36.

This paper presents the details of the theoretical prediction and design (atom by atom, bond by bond) of the molecule chemical structures of the first candidate super-strong liquid-crystalline polymers (SS LCPs). These LCPs are the *first* LCPs designed to have good compressive strengths, as well as to have tensile strengths and tensile moduli significantly larger than those of existing strong LCPs (such as Kevlar). The key feature of this new class of LCPs is that the exceptional strength is three dimensional on a microscopic, *molecular* level (thus, on a macroscopic level), in contrast to present LCPs (such as Kevlar) with their one-dimensional exceptional strength. These SS LCPs also have some solubility and processing advantages over existing strong LCPs. These SS LCPs are specially-designed combined LCPs such that the side chains of a molecule interdigitate with the side chains of other molecules. This paper also presents other essential general and specific features required for SS LCPs. Considerations in the design of SS LCPs include the spacing distance between side chains along the backbone, the need for rigid sections in the backbone and side chains, the degree of polymerization, the length of the side chains, the regularity of spacing of the side chains along the backbone, the interdigitation of side chains in submolecular strips, the packing of the side chains on one or two sides of the backbone, the symmetry of the side chains, the points of attachment of the side chains to the backbone, the flexibility and size of the chemical group connecting each side chain to the backbone, the effect of semiflexible sections in the backbone and side chains, and the choice of types of dipolar and/or hydrogen bonding forces in the backbones and side chains for easy alignment.

34928 Lifetimes of two-photon-emitting states in heliumlike and hydrogenlike nickel. Dunford, R. W. (Physics Division, Argonne National Laboratory, Argonne, Illinois 60439(US)); Hass, M.; Bakke, E.; Berry, H. G.; Liu, C. J.; Raphaelian, M. L. A.; Curtis, L. J. *Physical Review Letters (USA)*, 62(24): 2809-2812 (12 Jun 1989). DOE Contract FG05-88ER13958.

We report measurements of the lifetimes of the 2^1S_0 state of heliumlike Ni^{26+} and the $2^2S_{1/2}$ state of hydrogenlike Ni^{27+}, both of which decay predominantly by two-photon emission. Our method differs from previous measurements of the lifetimes of similar states in that we require a coincidence between the two photons. Our lifetime of 217.1(1.8) ps for the hydrogenlike decay is in agreement with the theoretical value of 215.45 ps. The heliumlike decay lifetime of 156.1(1.6) ps is in fair agreement with the theoretical value of 154.3(0.5) ps.

6404 Fluid Physics

34929 (AD-A–201263/1/XAB) **MPD (magnetoplasmadynamic) thrust-chamber flow dynamics. Annual technical report, 1 October 1987-30 September 1988.** R and D Associates, Alexandria, VA (USA). 30 Sep 1988. 28p. (RDA-TR–144200-002). Available from NTIS, PC A03/MF A01.

Magnetoplasmadynamic (MPD) arcjet thrusters inherently involve close coupling of the electromagnetic discharge structure and the flow field in the thrust chamber. The discharge and internal flow-field structures are not simply determined by the arcjet geometry, but depend on the values and partitioning of injected mass flow for each operating-current condition. In order to understand the internal flow dynamics of an MPD arcjet, experiments are performed in which electromagnetic fields and flow properties are measured within the thrust chamber. Electric and magnetic field probes are used to obtain the electromagnetic structure, while spectroscopic techniques are used to estimate particle velocities and densities.

34930 (CONF-8810118–9) **Momentum distributions in liquid helium.** Sokol, P.E.; Sosnick, T.R.; Snow, W.M. Argonne National Lab., IL (USA). 1988. 19p. Sponsored by DOE Energy Research. DOE Contract W-31109-ENG-38. From Workshop on momentum distributions; Argonne, Illinois, USA; 24-26 Oct 1988. Order Number DE89014679/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The appearance of the superfluid phase, with its unique macroscopic properties, and the success of the 'two-fluid' model in describing the transport properties are intimately linked to the Bose statistics obeyed by ^4He atoms. The most direct signature of the Bose condensate is in the single particle momentum distribution n(p). In the normal liquid the momentum distribution has a broad Gaussian shape, as predicted for classical systems, with a width determined by the quantum zero point motion. In the superfluid phase a new feature appears, the Bose condensate. The condensate appears as a δ-function singularity in n(p) with an intensity proportional to n_0, the condensate fraction. There has been extensive experimental work attempting to verify the existence of the condensate. Hohenberg and Platzman originally suggested that inelastic neutron scattering at high momentum transfer Q, where the Impulse Approximation IA can be used to directly relate the observed scattering to n(p), could provide a means of directly observing the condensate. In this review we will concentrate on recent experimental studies that utilize the large flux of high energy neutrons available at spallation neutron sources. These sources, which have become available only recently, have made it possible to make detailed measurements at large enough momentum transfers that the conditions for the Impulse Approximation are approximately satisfied. While deviations from the IA are still present at these higher Q's, they are more amenable to theoretical treatment and detailed predictions are available. Thus, even though no distinct condensate peak is observed, for the first time excellent agreement with the theoretical predictions for n(p) can be obtained. 50 refs., 12 figs.

34931 (IC–88/413) **Symmetry breaking phenomena in liquid Helium-4.** Ahmad, M.; Tikoo, S.K.; Raina, T.K. International Centre for Theoretical Physics, Trieste (Italy). Dec 1988. 50p. Order Number DE89618886/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Salient features of liquid Helium II are being analysed in the light of symmetry breaking mechanism. The excitation spectrum is derived by scaling transformation. A relation between roton excitation and Bogoliubov's quasi particles has been established by giving different structures to the roton operators, similar to quasi boson approximation for phonon-like spectrum. This structure of the roton operators enables us to study the low temperature behaviour of superfluid Helium-4 by introducing the idea of pairing for roton-like excitation for the on set of energy-gap. Superfluid He_4 is divided into the states of condensed bosons, oscillating condensed bosons,

phonons, maxons, rotons and the states of vortices. We consider the transition probabilities between these various states. Coherent states of various superfluid regions of He II are being obtained and consistently analysed which have deep inter-relationship. As higher excitations have also a group structure and their coherent behaviour has been seen, this formalism seems to be more appropriate to deal with such an interesting problem. (author). 108 refs.

34932 (INIS-mf–11456, pp. 383-386) **Superfluid ^{3}He phases in rotation.** Skrbek, L. (Ceskoslovenska Akademie Ved, Prague (Czechoslovakia). Fyzikalni Ustav). Jednota Ceskoslovenskych Matematiku a Fyziku, Prague (Czechoslovakia). 1987. (In Czech). (CONF-8707217–: 9. conference of Czechoslovak physicists, Pardubice, Czechoslovakia, 6-10 Jul 1987). In *Ninth conference of Czechoslovak physicists. Part 1, 2.* Order Number DE89617602/JAW. Available from NTIS (US Sales Only), PC A22/MF A01 - OSTI; INIS.

The behavior is described of quantized vortices in superfluid phases of ^{3}He. In the world there exist but two apparatur which can be used for such experiments. The following methods were used for the study of superfluid ^{3}He in rotation: NMR, the method of persisting currents and the method of negative current pulses. In the nuclei of vortices in ^{3}He-B there exists a phase transformation. The critical velocity has been measured for quantized vortices formation. In phase A singular vortices may exist as well as vortices with two nuclei. (M.D.). 4 figs., 15 refs.

34933 (KEK–88-3, pp. 8-24) **What can ultra cold neutrons tell us about superfluid ^{4}He?.** Griffin, A. (Kyoto Univ. (Japan). Dept. of Physics). National Lab. for High Energy Physics, Oho, Ibaraki (Japan). Jun 1988. (CONF-8803216–: 1. KEK symposium on ultra cold neutrons (UCN), Tsukuba, Japan, 10 Mar 1988). In *1st KEK symposium on ultra cold neutrons (UCN).* Order Number DE89012146/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

In this informal review, we discuss what are the current ideas about the nature of excitations in superfluid ^{4}He and some remaining puzzles. We emphasize the complementary roles of inelastic scattering of thermal neutrons and upscattering of UCNs. We briefly discuss the possible usefulness of UCNs in studying some of the consequences of the existence of a Bose condensate as well their interaction with second sound excitations.

34934 (UCRL–100203) **Numerical studies of shock wave structure sensitivity to interactions with turbulent fields.** Buckingham, A.C. Lawrence Livermore National Lab., CA (USA). Apr 1989. 10p. Sponsored by DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-890752–3: 6. international conference on numerical methods in laminar and turbulent flows, Swansea, UK, 11-15 Jul 1989). Order Number DE89012288/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This paper concerns the observed random changes to velocity, density, temperature, and pressure distributions induced in shock waves when weak shocks interact with relatively intense turbulence. Here numerical procedures are applied in order to examine this interaction process and to simulate its influence on turbulence. This interaction may be used as a diagnostic for ascertaining the distribution of interaction energy between competitive acoustic, entropy and vortical modes. Numerical procedures used here are supplements to physical experiments for tracking the dynamical mechanisms which may control the evolution of shock-turbulence interaction. The results are intended to provide assistance in the development and refinement of compressible turbulent closure models. They are obtained from use of a mixed Eulerian-Lagrangian semi-continuous rezoning finite difference method, a hybrid Euler/Lagrange pseudospectral method, and a Monte-Carlo random-choice procedure. The latter effectively magnifies the shock front region through use of finite range shock-transition integrals generating simulated interactive transition profiles. 11 refs., 6 figs.

34935 (UCRL–101020) **Computer experiments on LP jet injection stability and incipient breakup.** Buckingham, A.C.; Coffee, T.P. Lawrence Livermore National Lab., CA (USA). Apr 1989. 17p. Sponsored by Department of Defense. DOE Contract W-7405-ENG-48. (CONF-8905134–2: JANNAF propulsion meeting, Cleveland, Ohio, USA, 22-25 May 1989). Order Number DE89012967/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A hybrid Lagrangian (computational mesh moving with the center of mass of the fluid element) Eulerian (stationary, laboratory-frame computational mesh) fast Fourier transform (FFT) procedure and a continuously rezoned Lagrangian-Eulerian finite-difference procedure are modified here for study and analysis of LP jet injection dynamics. Specific attention is on development, test, and application of computer models which will predict influences of chamber pressure, jet-injection velocity and combustion energy release on the LP jet injection-flow configuration. The injection flow changes of particular interest are those which might signify tendencies for either jet stream segmentation and breakup or intact jet stream penetration of the entire combustion chamber in LP gun propulsion. Information also is sought on fuel segment size distribution following jet stream breakup, and the steady-state or oscillatory parameter changes that seem to most influence LP fuel segmentation. The initial studies emphasize the role of flow instabilities in forming or suppressing fuel-stream breakup and, perhaps, influencing subsequent segment or droplet-size distribution tendencies. Attention is focused, at present, on the primary Rayleigh-Taylor density penetration instability growth and secondary Kelvin-Helmholtz shear instability growth patterns. Response to naturally developed or forced, narrow-band oscillatory changes in the more influential parameters will be analyzed subsequently. 12 refs., 8 figs.

34936 Evaluation of the filtered leapfrog-trapezoidal time integration method. Roache, P.J. (Ecodynamics Research Associates, Inc., Albuquerque, NM (US)); Dietrich, D.E. *Numerical Heat Transfer (USA),* 14(2): 149-164 (1988).

An analysis and evaluation are presented for a new method of time integration for fluid dynamic proposed by Dietrich. The method, called the filtered leapfrog-trapezoidal (FLT) scheme, is analyzed for the one-dimensional constant-coefficient advection equation and is shown to have some advantages for quasi-steady flows. A modification (FLTW) using a weighted combination of FLT and leapfrog is developed which retains the advantages for steady flows, increases accuracy for time-dependent flows, and involves little coding effort. Merits and applicability are discussed.

34937 Hele-Shaw scaling properties of low-contrast Saffman-Taylor flows. DiFrancesco, M. W. (Department of Physics and Astronomy, University of Pittsburgh, Pittsburgh, Pennsylvania 15260(US)); Maher, J. V. *Physical Review [Section] A: General Physics (USA),* 40(1): 295-304 (1 Jul 1989).

We have measured variations of Saffman-Taylor flows by changingdimensionless surface tension *B* alone and by changing *B* inconjunction with changes in dimensionless viscosity contrast *A*. Ourlow-aspect-ratio cell permits close study of the linear- and earlynonlinear-flow regimes. Our critical binary-liquid sample allows study of verylow values of *A*. The predictions of linear stability analysis work wellfor predicting which length scales are important, but discrepancies areobserved for growth rates. We observe an empirical scaling law for growth ofthe Fourier modes of the patterns in the linear regime. The observed frontpropagation velocity for side-wall disturbances is constantly 2±1in dimensionless units, a value consistent with the predictions of Langer andof van Saarloos. Patterns in both the linear and nonlinear regimes collapseimpressively under the scaling suggested by the Hele-Shaw equations. Violationsof scaling due to wetting phenomena are not evident here, presumably becausethe wetting properties of the two phases of the critical binary liquid are sosimilar; thus direct comparison with large-scale Hele-Shaw simulations shouldbe meaningful.

34938 Generalization of the density-functional theory with application to three-body interactions in classical fluids. Iyetomi, H. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439(US)); Vashishta, P. *Physical Review [Section] A: General Physics (USA),* 40(1): 305-310 (1 Jul 1989). DOE Contract W-31-109-ENG-38.

An external field coupled with the two-body density distribution functionleads to a generalization of the density-functional theory in which the freeenergy is regarded as a functional not only of the density but also of thetwo-body distribution function. The generalized formalism is applied to theliquid-structure theory in the

presence of a weak three-body potential. In thefirst-order calculation, the three-body effects are fully taken into accountthrough modification of the pair potential; the structure of the pair-potentialtheory remains intact. Such a renormalizability, which was provendiagrammatically, is ascribed to the variational property of the free-energyfunctional. An approximate expression for the nonadditive correction which isamenable to the numerical computations is obtained within the hypernetted-chaintheory.

34939 Avalanches near a solid insulator in nitrogen gas at atmospheric pressure. Mahajan, S. M. (Department of Electrical Engineering, Tennessee Technological University, Box 5004, Cookeville, Tennessee 38505(US)); Sudarshan, T. S. *Journal of Applied Physics (USA),* 66(3): 1095-1102 (1 Aug 1989).

The pulsed Townsend (PT) technique was used to record the growth of avalanches near a solid insulator in nitrogen gas at 0.1 MPa. Several other nonconventional techniques for releasing initiatory electrons at the cathode are discussed. In this paper, experimental results of avalanches initiated by illuminating a fast (0.6-ns) nitrogen laser onto the cathode triple junction are presented. Data were recorded with plexiglas, Teflon, high-density polyethylene, low-density polyethylene, Delrin, etc. Effect of surface condition, variation of the distance between insulator surface and the avalanche initiation region, and the effect of a large number of previous avalanches on the avalanche characteristics at a particular voltage were studied. The Townsend primary ionization coefficient, hereafter referred to as growth coefficient (α), and drift velocity (V_e) were evaluated through the PT technique. Results indicate that the avalanche growth in the vicinity of a solid insulator is less than that in an identical plain gas gap. Existence of a nonuniform field as a result of surface charges on the insulator and/or field modifications due to the avalanche space charge are believed to be responsible for this behavior.

34940 Cathode ions from microsecond aluminum vacuum arcs. Miller, H. C. (General Electric Neutron Devices, Largo, Florida 34649(US)). *Journal of Applied Physics (USA),* 66(3): 1107-1112 (1 Aug 1989).

A triggered vacuum gap with a 1.25-mm-diam aluminum cathode, a nickel mesh anode, and a separate two-terminal gold trigger, were used to generate vacuum arcs of 60–90 A, 6–40 μs in duration. A retarding potential analyzer was used to investigate the cathode ion flux. A typical ion signal showed an initial peak about 10–20 μs after arc initiation, followed by a rapid decay, then the signal leveled off at about 30–35 μs to a fairly constant signal (plateau), which persisted until a few microseconds after the arc current was cut off; finally the ion signal decayed to zero. The initial peak was primarily composed of ions produced during the initial stage of the vacuum arc. The plateau represented ions produced after the arc settled down to a reasonably steady state. Conclusions were as follows: (1) The cathode ions produced during the initiation stage of such vacuum arcs are more energetic than those produced after the arc has settled down to a steady state, and (2) after this steady state has been reached, the cathode ion flux still appears somewhat more energetic than the cathode ion flux from dc vacuum arcs, although this may be because of the higher arc voltage caused by the relatively small ratio of electrode diameter to gap length in these experiments.

34941 Nonlinear evolution and breaking of interfacial Rayleigh–Taylor waves. Oron, A. (Center for Nonlinear Studies, Los Alamos National Laboratory, Los Alamos, New Mexico 87545(US)); Rosenau, P. *Physics of Fluids A: Fluid Dynamics (USA),* 1(7): 1155-1165 (Jul 1989). DOE Contract W-7405-ENG-36.

The nonlinear evolution of interfacial waves separating liquids of differentviscosity and density (Rayleigh–Taylor instability) in a 2-D channel isstudied. Using a new approach, which accounts for large gradients, the nonlinearevolution of the interface, $y=\epsilon A(\tau,\xi), \epsilon \ll 1$, is shown tobe governed by the regularized Kuramoto–Sivashinsky equation $A_\tau+\beta AA_\xi+\{\alpha A+\gamma A_{\xi\xi}/(1+\epsilon^4 A^2_\xi)^{3/2}\}_{\xi\xi}=0$,where the constants α,β, and γ are determinedat equilibrium, ξ is the slow coordinate along the channel,$\xi=\epsilon(x-c_0 t)$, and $\tau=\epsilon^2 t$. It is shownnumerically that for $\epsilon^2 \geq 0.1\beta$ linearly unstable waves (while alwaysof finite amplitude) are propelled by convection toward breaking in a finitetime.

6450 High Energy Physics

34942 (ANL-HEP-CP–89-50) **Portable parallel programming in a Fortran environment.** May, E.N. Argonne National Lab., IL (USA). 1989. 16p. Sponsored by DOE Energy Research. DOE Contract W-31109-ENG-38. (CONF-890415–3: Computing in high energy physics, Oxford, UK, 10-14 Apr 1989). Order Number DE89014670/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Experience using the Argonne-developed PARMACs macro package to implement a portable parallel programming environment is described. Fortran programs with intrinsic parallelism of coarse and medium granularity are easily converted to parallel programs which are portable among a number of commercially available parallel processors in the class of shared-memory bus-based and local-memory network based MIMD processors. The parallelism is implemented using standard UNIX (tm) tools and a small number of easily understood synchronization concepts (monitors and message-passing techniques) to construct and coordinate multiple cooperating processes on one or many processors. Benchmark results are presented for parallel computers such as the Alliant FX/8, the Encore MultiMax, the Sequent Balance, the Intel iPSC/2 Hypercube and a network of Sun 3 workstations. These parallel machines are typical MIMD types with from 8 to 30 processors, each rated at from 1 to 10 MIPS processing power. The demonstration code used for this work is a Monte Carlo simulation of the response to photons of a "nearly realistic" lead, iron and plastic electromagnetic and hadronic calorimeter, using the EGS4 code system. 6 refs., 2 figs., 2 tabs.

34943 (DOE/ER/40319–3-Pt.1.) **[High energy particle physics]: Progress report covering the five year period from August 1, 1984 to May 31, 1989 with special emphasis for the period of August 1, 1988 to May 31, 1989: Part 1.** Florida State Univ., Tallahassee, FL (USA). Dept. of Physics. 1989. 128p. Sponsored by DOE Energy Research. DOE Contract FG05-87ER40319. Order Number DE89013020/JAW. Available from NTIS, PC A07/MF A01 - OSTI; GPO Dep.

In this document the High Energy Physics group reviews its accomplishments and progress during the past five years, with special emphasis for the past year and presents plans for continuing research during the next several years. During the last few years the effort of the experimental group has been divided approximately equally between fixed target physics and preparations for future collider experiments. The main emphasis of the theory group has been in the area of strong and electroweak phenomenology with an emphasis on hard scattering processes. With the recent creation of the Supercomputer Computations Research Institute, some work has also been done in the area of numerical simulations of condensed matter spin models and techniques for implementing numerical simulations on supercomputers.

34944 (ISN–87-97) **European hadron facility.** Scheck, F.; Bradamante, F.; Richard, J.M. Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires. May 1987. 11p. (CONF-8705378–: Erice school on physics witts low-energy antiprotons, Erice, Italy, May 1987). Order Number DE89781513/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

In this contribution we survey the physics potential of a facility such as EHF in somewhat general terms. In other words, we outline some fundamental questions in nuclear physics and low energy particle physics to whose advancement EHF can and will make substantial contributions, without going into specific experiments needed to answer them. It is the role of the case studies, presented in the EHF proposal(1), to illustrate the kind of experimental effort (typical beam requirements, characteristic detectors, size of experiments, etc.) needed at EHF for the physics one wishes to clarify.

34945 (LBL–26466) **Physics Division activities report, 1986–1987.** Lawrence Berkeley Lab., CA (USA). 1987. 137p. Sponsored by DOE Energy Research. DOE Contract AC03-76SF00098. Order Number DE89013351/JAW. Available from NTIS, PC A07/MF A01 - OSTI; GPO Dep.

This report summarizes the research activities of the Physics Division for the years 1986 and 1987. Areas of research discussed in this paper are: research on e^+e^- interactions; research on $p\bar{p}$ interactions; experiment at TRIUMF; double beta decay; high energy

astrophysics; interdisciplinary research; and advanced technology development and the SSC.

6451 Particle Interactions and Properties - Experimental

Refer also to citation(s) 34317, 34770, 34966

34946 (ANL-HEP-CP–89-40) **Electron identification in the CDF [Collider Detector at Fermilab] central calorimeter.** Proudfoot, J. Argonne National Lab., IL (USA). 1989. 8p. Sponsored by DOE Energy Research. DOE Contract W-31109-ENG-38. (CONF-890379–8: Workshop on calorimetry for the SSC, Tuscaloosa, Alabama, USA, 13-17 Mar 1989). Order Number DE89014672/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Efficient identification of electrons both from W decay and QCD heavy flavour production has been achieved with the CDF Central Calorimeter, which is a lead – scintillator plate calorimeter incorporating tower geometry. The fine calorimetry granularity (0.1 x 0.26 in η, ϕ space) allows identification of electrons well within the typical jet cone and is wholly sufficient for the measurement of the isolation of electrons from W decay. With minor improvements, such a detector is a realistic option for electron identification in the central rapidity region at the SSC. 1 ref., 7 figs.

34947 (CRN-HE–8608) **Background estimates and limits on compositeness at LEP $Z^0 \rightarrow \gamma\gamma\ \gamma$ and e^* search.** Bloch, D. Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires. 1986. 18p. (CONF-8609223–: ECFA workshop: LEP 200, Aachen, Germany, F.R., 29 Sep - 1 oct 1986). Order Number DE89781502/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Background is computed and limits are presented at LEP I and LEP II energies on processes characteristic for Compositeness: rare Z^0 boson decay into 3 photons; excited electron e^* production in single mode; and virtual e^* exchange.

34948 (CRN-PN–88-22) **Study of meson production in 200 A. GeV Ion collisions using decay muons.** NA38 Collaboration. Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires. 1988. 9p. (CONF-880280–: International conference on physics and astrophysics of quark-gluon plasma, Bombay, India, 8-12 Feb 1988). Order Number DE89781488/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

The like-sign muon pairs copiously recorded in the high luminosity NA38 experiment are interpreted as resulting from decays of π and K mesons. It is shown that the muon properties reflect the pion and kaon ones. The average transverse momentum is found to be similar for p-U,O^{16}-U and S^{32}-U reactions. The K/π ratio, which indicates strangeness production, is also the same for the three reactions. Both measurements increase slightly with E_T.

34949 (DOE/ER/40125–17) **Indiana University high energy physics, Task A: Technical progress report, December 1, 1988–December 31, 1989.** Blockus, D.; Brabson, B.B.; Crittenden, R.R.; Dzierba, A.R.; Hanson, G.; Martin, H.J.; Marshall, T.; Ogren, H.O.; Rust, D.; Snyder, A. Indiana Univ., Bloomington, IN (USA). Dept. of Physics. 1989. 59p. Sponsored by DOE Energy Research. DOE Contract AC02-84ER40125. Order Number DE89013106/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

This paper discusses the following topics: meson spectroscopy; hybrid search; mesons with unusual quantum numbers; hadronic jets; high mass dimuons; DO collider detector; High Resolution Spectrometer; B factory; Mark II Z^0 physics; and SLAC polarization.

34950 (INIS-mf–11456, pp. 405-408) **Experimental results from Europhysics conference in Uppsala.** Cvach, J. (Ceskoslovenska Akademie Ved, Prague (Czechoslovakia). Fyzikalni Ustav). Jednota Ceskoslovenskych Matematiku a Fyziku, Prague (Czechoslovakia). 1987. (In Czech). (CONF-8707217–: 9. conference of Czechoslovak physicists, Pardubice, Czechoslovakia, 6-10 Jul 1987). In *Ninth conference of Czechoslovak physicists. Part 1, 2.* Order Number DE89617602/JAW. Available from NTIS (US Sales Only), PC A22/MF A01 - OSTI; INIS.

A survey is given of experimental results which were presented at the Europhysics conference on high energy physics in Uppsala in 1987. The experiments concerned the measurement of neutrino mass, the flow of solar neutrinos, neutrino oscillations, proton life, top quark rest energy and tests of the standard model of electroweak and strong interactions. (Z.J.). 2 figs., 1 tab., 8 refs.

34951 (IPNO-TH–87-83) **New heavy quark physics in the strongly Yukawa coupled standard model.** Soni, V.; Moussallam, B.; Hadjitheodoris, S. Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire. Aug 1987. 26p. Order Number DE89781492/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

We show that for strong enough Yukawa coupling and weak gauge coupling the electroweak standard model quark finds it energetically advantageous to transform itself into a bound state in a Skyrme background. The mass of such a 'heavy' quark as also the heavy nucleon (a three quark color singlet composite) then decreases with the Yukawa coupling resulting in a maximum for the quark (nucleon) of 2 TeV (3 TeV). The three quark bound state, that is the nucleon, can be very strongly bound in this sheme in contrast to the weak binding mediated by QCD gluon exchange. As a candidate for new phenomenology at the SSC we find that the decay of a Δ like excited state of the heavy nucleon into W_L plus heavy nucleon could provide an experimental signature of this scheme.

34952 (JINR-D–1-88-368) **Observation of narrow baryoniums in the experiment BIS-2. 1. Strange baryoniums.** Aleev, A.N.; Aref'ev, V.A.; Balandin, V.P. and others. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy. 1988. 8p. Order Number DE89618956/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Submitted to the 24-th International Conference on High Energy Physics, FRG, August, 1988, and to International Conference Quarks-88, Tbilisi, May 1988.

The search has been performed for baryoniums decaying into the Λ,p-bar (or Λ-bar,p) and pions in the experiment carried out by the BIS-2 collaboration at the Serpukhov accelerator. In seven invariant mass spectra of the different final states near the same mass value of 3050 MeV/c^2, narrow peaks are seen, which indicates the existence of baryoniums with negative and positive strangenesses and charged states: +2, +1, 0, -1 and -2. The mean mass value of the baryoniums equals: 3050$\pm$10 (stat.) $\pm$30(syst.). MeV/c^2. The width of the baryoniums does not exceed 30 MeV/c^2. The presence of the double charged states of the baryoniums shows that their isotopical spin is $\geq$3/2. This indicates to their multiquark structure. The indication to the existence of a narrow baryonium with the mass of 2400 MeV/c^2 in the Λ-barp system was obtained also. 11 refs.; 4 figs.; 2 tabs.

34953 (JINR-D–1-88-369) **Observation of narrow baryoniums in the experiment BIS-2. 2. Baryoniums with hidden strangeness.** Aleev, A.N.; Aref'ev, V.A.; Balandin, V.P. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy. 1988. 6p. Order Number DE89618957/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Submitted to the 24-th International Conference on High Energy Physics, FRG, August, 1988, and to International Conference Quarks-88, Tbilisi, May, 1988.

In the experiment carried out by the BIS-2 collaboration at the Serpukhov accelerator the search has been performed for baryonium with hidden strangeness, decay products of which are containing baryon-antibaryon pair, and also particles with opposite strangenesses. In eight different invariant mass spectra of the neutral and charged final states, the narrow peaks are observed at one and the same mass value. This indicates the existence of the non-strange baryonium in three charged states: +1,0 and -1. The mass of the resonance is equal to 3255$\pm$10 (stat.)$\pm$30(syst.) MeV/c^2. The width of the resonance does not exceed 30 MeV/c^2. 7 refs.; 3 figs.; 1 tab.

34954 (UEF–02-88) **Backward particles in ^{4}Hep reactions.** Glagolev, V.V.; Lebedev, R.M.; Pestova, G.D.; Shimansky, S.S.; Seman, M.; Sandor, L.; Hlavacova, J.; Martinska, G.; Patocka, J.; Urban, J. Slovenska Akademia Vied, Kosice (Czechoslovakia). Ustav Experimentalnej Fyziky. Aug 1988. 15p. Order Number DE89617840/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The invariant differential cross sections were investigated as functions of different backward particle momenta in ^{4}Hep interactions. Two data samples were used at the ^{4}He incident momenta 8.6 GeV/c and 13.6 GeV/c. The data were obtained by means of a 1-m hydrogen bubble chamber at Joint Institute for Nuclear Research Dubna. The spectra for nuclei showed a monotonous exponentially falling trend at both momenta. Some irregularities were observed in the nucleon and P^+ spectra and these were especially visible at a lower beam momentum. The experimental data were satisfactorily reproduced by taking into account the Fermi motion and intermediate Δ-isobar states. (author). 7 figs., 2 tabs., 22 refs.

34955 Production of meson resonances as leading particles in jets in proton-proton collisions at $\sqrt{s}$=62 GeV at the CERN ISR. Breakstone, A. (Ames Lab., IA (USA)); Crawley, H.B.; Firestone, A.; Gorbics, M.; Isenhower, D.; Lamsa, J.W.; Meyer, W.T.; Skeens, J.; Campanini, R.; Cuffiani, M. *Zeitschrift fuer Physik [Sektion] C: Particles and Fields (F.R. Germany)*, 43(2): 185-192 (Jun 1989). DOE Contract W-7405-ENG-82;AC03-76SF00098.

The production of rho(770)^0, K*(892)^0, anti K*(892)^0 and f_2(1270) mesons as leading particles in hadron jets ($\langle z \rangle \simeq 0.7$) has been measured in deep inelastic pp interactions at the CERN ISR at $\sqrt{s}$=62 GeV. The comparison of vector and pseudoscalar meson production at the same transverse momentum provides a rather model independent way to determine the fragmentation parameter V/P. We determine $(V/P)_{u,d}$=1.66±0.18±0.63 from the rho/π ratio and $(V/P)_s$=0.90±0.13±0.27 from the K*/K ratio. For the f_2(1270) production we find f_2/rho^0=0.30±0.08.

34956 Search for free quarks produced at 800 GeV/c using a new concentration technique. Matis, H.S. (Nuclear Science Division, Lawrence Berkeley Laboratory, 1 Cyclotron Road, Berkeley, California 94720); Pugh, H.G.; Bland, R.W.; Calloway, D.H.; Dickson, S.; Hodges, C.L.; Joyce, D.; Lindgren, M.A.; Palmer, T.L.; Savage, M.L.; and others. *Physical Review [Section] D: Particles and Fields (USA)*, 39(7): 1851-1860 (1 Apr 1989).

A high-sensitivity experiment was performed to detect free quarks produced in collisions of 800-GeV/c protons with a heavy target at Fermilab. Two quite different, high-concentration methods were used to obtain a small drop of Hg containing any produced quarks which stopped in a large amount of material. Using a new technique, secondaries were stopped in Hg tanks and the Hg was then distilled to small drops. In a second method, secondaries were stopped in liquid-nitrogen tanks, and charged atoms were collected electrostatically on Au-coated electrodes. The Au coatings were dissolved in Hg. The Hg drops from both techniques were then tested for quarks in the San Francisco State University automated Millikan apparatus. These results show that charged 1/3 quarks are produced below levels of 1.2×10^{-10} at 90% C.L. for both methods. Upper limits are also presented for charged 2/3 quarks. The distillation technique should prove useful in performing high-sensitivity quark searches in future beam-dump experiments.

34957 Dijet angular distributions from $p\bar{p}$ collisions at $\sqrt{s}$=1.8 TeV. Abe, F. (Argonne National Laboratory, Argonne, Illinois 60439(US)); Amidei, D.; Apollinari, G.; Ascoli, G.; Atac, M.; Auchincloss, P.; Baden, A. R.; Barbaro-Galtieri, A.; Barnes, V. E.; Bedeschi, F.; and others. *Physical Review Letters (USA)*, 62(26): 3020-3023 (26 Jun 1989).

We have measured dijet angular distributions at $\sqrt{s}$ =1.8 TeV with the Collider Detector at Fermilab and the Tevatron $\bar{p}$ Collider and find agreement with leading-order QCD. By comparing the distribution for the highest dijet invariant masses with the prediction of a model of quark compositeness, we set a lower limit on the associated scale parameter Λ_c at 330 GeV (95% C.L.).

34958 Spin-correlation parameter $A_{nn}(\theta)$ for *n-p* elastic scattering at 790 MeV. Nath, S. (Texas A&M University, College Station, Texas 77843-3366(US)); Glass, G.; Hiebert, J. C.; Holt, J. A.; Kenefick, R. A.; Northcliffe, L. C.; Grosnick, D. P.; Lopiano, D.; Ohashi, Y.; Shima, T.; and others. *Physical Review [Section] D: Particles and Fields (USA)*, 39(11): 3520-3523 (1 Jun 1989). DOE Contract AS05-76ER04449;W-31-109-ENG-38;FG05-88ER40399.

The spin-correlation parameter A_{nn} for free *n*-pelastic scattering has been measured for the first time forincident-neutron-beam energy E_n=790 MeV and c.m. angles$48° \lesssim \theta^* \lesssim 149°$. The data are compared with thewidely differing predictions of several phase-shift analyses, clearly favoringone of them. They also are compared with recently published quasifreeA_{nn} data for the more limited c.m. angular region$98° \lesssim \theta^* \lesssim 122°$.

6452 Particle Interactions and Properties - Theoretical

Refer also to citation(s) 34873, 35005, 35114, 35173, 35312, 35329

34959 (DOE/ER/40125–18) **Theoretical particle physics: Technical progress report, May 1988–May 1989.** Hendry, A.W.; Kostelecky, V.A.; Lichtenberg, D.B. Indiana Univ., Bloomington, IN (USA). Dept. of Physics. May 1989. 51p. Sponsored by DOE Energy Research. DOE Contract AC02-84ER40125. Order Number DE89013107/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

During 1988–1989, we have carried out research on solar neutrinos, supersymmetry and superstring theory, the quark model, and lattice gauge theory. Interesting results have been obtained in each of these areas.

34960 (DOE/ER/40125–20) **Theoretical particle physics: Technical progress report, May 1, 1988–April 30, 1989.** Gottlieb, S.A. Indiana Univ., Bloomington, IN (USA). Dept. of Physics. May 1989. 17p. Sponsored by DOE Energy Research. DOE Contract AC02-84ER40125. Order Number DE89013105/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

My research in lattice gauge theory during the past year is described. Several projects were completed dealing with QCD simulations including dynamical fermions. The phase diagram for QCD with four quark flavors was studied using a finite size scaling analysis at intermediate quark mass. With two light quark flavors, a study of the hadron spectrum was completed. These results, when combined with an earlier study of the finite temperature chiral symmetry restoration transition, determine the transition temperature in MeV. The transition temperature is seen to be ≈130 MeV, which makes it more accessible to observation at a relativistic heavy-ion collider than previously expected. Studies of hadronic screening lengths and the quark number susceptibility at zero chemical potential provide further probes of the high temperature phase of QCD. In the pure gluon theory, claims that the finite temperature deconfinement transition is second order, rather than first order, were investigated using a finite size scaling analysis. Finally, work was done to port computer code to new environments in order to pursue more ambitious calculations on more powerful hardware than the ST-100 used for the calculations reported here.

34961 (DOE/ER/40319–3-Pt.2) **[High energy particle physics]: Progress report covering the five year period from August 1, 1984 to May 31, 1989 with special emphasis for the period of August 1, 1988 to May 31, 1989.** Florida State Univ., Tallahassee, FL (USA). Dept. of Physics. 1989. 35p. Sponsored by DOE Energy Research. DOE Contract FG05-87ER40319. Order Number DE89013021/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This report summarizes the research done. One may identify the following mainlines: finite size scaling and non-Abelian gauge theories in finite volumes; random surfaces; quantum gravity; and algorithms, statistical and computational methods. A short account of each topic (and their interrelations) is given.

34962 (FNAL/C–89/26) **Structure functions and parton distributions.** Tung, Wu-Ki; Morfin, J.G.; Schellman, H.; Kunori, S.; Caldwell, A.; Olness, F. Fermi National Accelerator Lab., Batavia, IL (USA). Jan 1989. 49p. Sponsored by DOE Energy Research. DOE Contract AC02-76CH03000. (CONF-8806243–40: DPF summer study: Snowmass '88: high energy physics in the 1990s, Snowmass, Colorado, USA, 27 Jun - 15 jul 1988;ANL-HEP-CP–89-01). Order Number DE89014215/JAW. Available from NTIS, PC A03/MF A01 - OSTI.

Parton distributions play an essential role in the QCD parton model in studies of all high energy processes in physics of the 1990's. The primary source of information on parton distributions is from structure functions measured in deep inelastic scattering experiments. In this report we: review the current status of deep

inelastic scattering experiments; closely examine the efficacy of currently used parton distribution parametrizations; report on our efforts to compile an extensive database on structure functions and to initiate a comprehensive study of the extraction of parton distributions from them; present preliminary results and conclusions from this study; and discuss the important roles that current and near-future experiments (especially at the colliders) can play in the complete determination of parton distributions. Particular attention is placed in the gluon distribution and on the small-x extrapolation problem. A concise summary of precise definitions of parton distributions and QCD parton model formulas are included in the introductory section to meet the increasing need of next-to-leading order applications of QCD. 47 refs.

34963 (HD-THEP–88-5) **CP violating mixings of toponium states.** Loew, U. Heidelberg Univ. (Germany, F.R.). Inst. fuer Theoretische Physik; Heidelberg Univ. (Germany, F.R.). Naturwissenschaftlich-Mathematische Gesamtfakultaet. 1988. 78p. (In German). Available from Heidelberg Univ. (Germany, F.R.). Inst. fuer Theoretische Physik.

In the present thesis the possibility of an admixture chi of the 2^1P_1 toponium state which has the CP quantum number -1 to the 2^3S_1 toponium state with CP quantum number +1 is discussed. The value of chi was estimated in 3 different models of the electroweak interaction. In the standard model the lowest contribution to chi is of 6th order in the weak coupling g or of 4th order in g and of 2nd order in the strong coupling g_S. The Feynman diagrams which contribute to chi contain 2 loops. According to a crude estimate of these diagrams it is expected that they yield a contribution smaller than 10^{-10}. In the model with extended Higgs sector - for a top-quark mass of 45 GeV - a value of $7x10^{-4}$ resulted for chi. For a top-quark mass of 100 GeV it is expected that chi is even of the order of magnitude of 10^{-2}. The large contributions originate from CP violating coupling neutral Higgs particles. In the right-left symmetric model two contributions to chi were calculated. The first one results from the exchange of the right- and left-handed W bosons. For a mass m_R=500 GeV this contribution lies at chi $\simeq 10^{-14}$. The second contribution is again based on the exchange of two neutral CP violating coupling Higgs particles. It lies in the order of magnitude at 10^{-8}. Possibilities were indicated to find the estimated admixture chi in an experiment. A correlation in the 3-gluon decay of toponium and the decay of toponium into exclusive decays was discussed. (orig./HSI).

34964 (IC–88/344) **Extraction of higher twist contribution from large P_T rho photoproduction processes.** Hu Tong; Kong Fanmei; Ma Luo. International Centre for Theoretical Physics, Trieste (Italy). Nov 1988. 12p. Order Number DE89617793/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

We propose a method by using cross section differences to extract higher twist contributions from large P_T-photoproduction processes. The calcuation shows that this method can obtain a clear higher twist signature and can be carried out under the present available laboratory conditions. In this paper, we have compared several rho meson wave functions, and indicated that the different results of the combination of the cross sections have been given for different rho meson wave functions. (author). 7 refs, 3 figs, 1 tab.

34965 (IFUSP-P–723) **Gentileons of the first kind.** Cattani, M.S.D. Sao Paulo Univ., SP (Brazil). Inst. de Fisica. Jul 1988. 27p. Order Number DE89618942/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Fundamental aspects of the gentilionic theory are reanalyzed and significant modifications are introduced in this approach. It is shown that the state vector of three gentileons has a spinor character and that its basic symmetry properties are described by the intermediate S_3 and SU(3) groups. As an intermediated and natural result of the oretical analysis, it is shown how essential observed properties of composed can be predicted from first principles assuming quarks as gentileons.

34966 (IFUSP-P–729) **40 years of meson pi.** Hamburger, E.W. Sao Paulo Univ., SP (Brazil). Inst. de Fisica. Aug 1988. 10p. (In Portuguese). Order Number DE89618891/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

The history of meson pi discovery and, its consequences for the development of elementary particle physics are presented. (M.C.K.).

34967 (IFUSP-P–734) **Heavy lepton production through vector boson fusion in e^+ e^- collisions at high energies.** Eboli, O.J.P.; Marques, G.C.; Novaes, S.F. Sao Paulo Univ., SP (Brazil). Inst. de Fisica. Sep 1988. 17p. Order Number DE89618910/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The production of heavy leptons belonging to a fourth generation, through the vector boson fusion mechanism in e^+e^- collisions at CLIC energies is studied. Lepton production through photon fusion is a more efficient mechanism since the total cross section is larger for a considerable range of lepton masses. Only for very high masses the fusion of longitudinally polarized bosons becomes competitive with photon fusion.

34968 (IFUSP-P–752) **Superheavy quarkonium decays with two higgs doublets.** Eboli, O.J.P.; Natale, A.A.; Simao, F.R.A. Sao Paulo Univ., SP (Brazil). Inst. de Fisica. Nov 1988. 38p. Order Number DE89618943/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The decay modes of a S-wave superheavy quarkonium, formed by a possible fourth generation quark in two Higgs doublets models are studied. Due to the enhacement of Yukawa couplings and longitudional weak bosons the main decays of these superheavy states will be into neutral scalar bosons, $H^0_iH^0_j$, and a charged scalar plus a W boson. If the $H^{-+}W^{\pm}$ channel is open for the psi(1^{--}) superheavy quarkonium provide a quite clean signal for a charged Higgs boson. The decay of the pseudoscalar quarkonium eta(O^{-+}) into a zeta boson and one of the scalars will also be present in a large amount.

34969 (IFUSP-P–755) **S-> dγ contribution to hyperon radiative decays: a QCD sum rule approach.** Goldman, C.; Escobar, C.O. Sao Paulo Univ., SP (Brazil). Inst. de Fisica. Nov 1988. 25p. Order Number DE89618944/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Using the method of the QCD sum rules, the short distance contribution s-> dγ to the hyperon radiative decays, $\Sigma^+ \to p\gamma$ and $\gamma^- \to \Sigma^-\gamma$ is analysed. A more reliable estimate of this contribution is obtained, giving branching ratios that are larger than obtained before for the same process, although still small compared with experimental data. The asymmetric parameter α turns out to depend on the decay considered and surprising is equal to -1 for $\Sigma^+ \to p\gamma$, for dynamical reasons which will discuss.

34970 (INFN-LNF–89-008(PT)) **Model of diffraction scattering with unitary corrections.** Etim, E.; Malecki, A.; Satta, L. Istituto Nazionale di Fisica Nucleare, Rome (Italy). 1989. 14p. (CONF-8906125–: Workshop on multiparticle dynamics, Perugia, Italy, 21-28 Jun 1989). Order Number DE89612645/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The inability of the multiple scattering model of Glauber and similar geometrical picture models to fit data at Collider energies, to fit low energy data at large momentum transfers and to explain the absence of multiple diffraction dips in the data is noted. It is argued and shown that a unitary correction to the multiple scattering amplitude gives rise to a better model and allows to fit all available data on nucleon-nucleon and nucleus-nucleus collisions at all energies and all momentum transfers. There are no multiple diffraction dips.

34971 (INIS-mf–11456, pp. 35-42) **Old and new problems in the neutrino physics.** Gmitro, M. (Ceskoslovenska Akademie Ved, Rez (Czechoslovakia). Ustav Jaderne Fyziky). Jednota Ceskoslovenskych Matematiku a Fyziku, Prague (Czechoslovakia). 1987. (In Czech). (CONF-8707217–: 9. conference of Czechoslovak physicists, Pardubice, Czechoslovakia, 6-10 Jul 1987). In *Ninth conference of Czechoslovak physicists. Part 1, 2.* Order Number DE89617602/JAW. Available from NTIS (US Sales Only), PC A22/MF A01 - OSTI; INIS.

A survey is presented of the present state of the physics of the neutrino. Attention is centred on the determination of the neutrino mass, neutrino-free double beta decay, neutrino oscillation, the mystery of solar neutrinos and the Supernova 1987 explosion. (Z.J.). 2 tabs., 14 refs.

34972 (INIS-mf–11456, pp. 51-58) **New ideas on space-time and particles.** Niederle, J. (Ceskoslovenska Akademie Ved, Prague (Czechoslovakia). Fyzikalni Ustav). Jednota Ceskoslovenskych Matematiku a Fyziku, Prague (Czechoslovakia). 1987. (In Czech). (CONF-8707217–: 9. conference of Czechoslovak physicists, Pardubice, Czechoslovakia, 6-10 Jul 1987). In *Ninth conference of Czechoslovak physicists. Part 1, 2.* Order Number DE89617602/JAW. Available from NTIS (US Sales Only), PC A22/MF A01 - OSTI; INIS.

The present state of the theory of superstrings is described. Their priciple is explained and a survey given. It is pointed out that the theories of superstrings are the only theories which consistently link the gravitation theory with quantum theory and allow to describe all known subnuclear particles and their interactions. (Z.J.). 9 figs., 3 tabs., 10 refs.

34973 (INIS-mf–11456, pp. 419-422) **Is there an experimental proof that nucleons in nuclei are substantially different from free ones?.** Formanek, J. (Karlova Univ., Prague (Czechoslovakia). Fakulta Matematicko-Fyzikalni). Jednota Ceskoslovenskych Matematiku a Fyziku, Prague (Czechoslovakia). 1987. (In Czech). (CONF-8707217–: 9. conference of Czechoslovak physicists, Pardubice, Czechoslovakia, 6-10 Jul 1987). In *Ninth conference of Czechoslovak physicists. Part 1, 2.* Order Number DE89617602/JAW. Available from NTIS (US Sales Only), PC A22/MF A01 - OSTI; INIS.

The deep inelastic scattering of muons on atomic nuclei is discussed. Main attention is focused on the interpretation of experimental data measured in CERN by the European Muon Collaboration (EMC effect). There does not appear to exist experimental evidence that nucleons in nuclei substantially differ from free nucleons. (Z.J.). 3 figs., 4 refs.

34974 (INIS-mf–11456, pp. 409-412) **Topical problems of the standard model.** Fischer, J. (Ceskoslovenska Akademie Ved, Prague (Czechoslovakia). Fyzikalni Ustav). Jednota Ceskoslovenskych Matematiku a Fyziku, Prague (Czechoslovakia). 1987. (In Czech). (CONF-8707217–: 9. conference of Czechoslovak physicists, Pardubice, Czechoslovakia, 6-10 Jul 1987). In *Ninth conference of Czechoslovak physicists. Part 1, 2.* Order Number DE89617602/JAW. Available from NTIS (US Sales Only), PC A22/MF A01 - OSTI; INIS.

The present state is described of the standard model and some of its topical problems are discussed, this namely the number of free parameters, the existence and properties of Higgs bosons, the possible existence of right-spin calibration bosons W^{+}_{R}, W^{-}_{R}, Z_R and the top quark. (Z.J.). 12 refs.

34975 (JINR-E–2-88-395) **Extra Z'-boson in elastic and diffractive neutrino scattering.** Bednyakov, V.A.; Kovalenko, S.G. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems. 1988. 21p. Order Number DE89618894/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Submitted to the journal Yad. Fiz.

The contribution of the extra Z' boson to elastic νN or (ν-barN), νe or (ν-bare) scattering, coherent neutrinoproduction of π^0 mesons on nuclei, diffractive neutrino reactions with rho^0-and and $A_1{}^0$ mesons produced have been studied within the superstring inspired E_6 model. Some combinations of charged and neutral current cross sections weakly depending on the nucleon and nuclear structure have been analyzed. The conclusion that it is reasonable to study experimentally the Z' contribution not only in deep inelastic processes but also in the above ones is substantiated. Possibilities of carrying out these investigations at relatively low energies are discussed. 16 refs.; 10 figs.; 3 tabs.

34976 (JINR-E–2-88-428) **Spin effects in QCD at large distances.** Goloskokov, S.V. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics. 1988. 12p. Order Number DE89618912/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Submitted to the journal Yad. Fiz.

The high-energy quark-quark scattering is investigated without using the QCD perturbative theory. It is shown that the two-gluon-object exchange in the t-channel leads to the helicity-flip amplitude growing as S which contains the constituent quark mass as a dimensional parameter. The existence in some diagrams of perturbative theory of QCD. 13 refs.; 4 figs.

34977 (JINR-E–2-88-460) **About a possibility for observation of CP-violation in B-meson decays in fixed target experiments.** Kekelidze, V.D. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy. 1988. 12p. Order Number DE89618913/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Submitted to the journal Z. Phys., C.

An approach to rhe detection of CP-violation tn the decays of neutral B mesons at fixed target accelerators is suggested. This approach is feasible in experiments with high intensity hadron beams and, thus, allows one to employ one of the main advantages of fixed target accelerators. Possible systematic errors of the CP asymmetry measurement are also discussed. The B^o decays into J/psi+K_s and J/psi+K_l are considered as an optimum for the detection of CP-violation. 14 refs.

34978 (JINR-E–2-88-465) **Scalar gluonium candidates and the radiative J/PSI decays.** Lanik, J.; Safarik, K. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics; Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems. 1988. 14p. Order Number DE89618914/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Submitted to the journal Czech. J. Phys.

Possible productions of scalar gluonium candidates in the radiative J/PSI decays are discussed. 27 refs.; 2 figs.

34979 (JINR-E–2-88-519) **Polarizability of π-mesons in the quark confinement model.** Avakyan, E.Z.; Avakyan, S.L.; Efimov, G.V.; Ivanov, M.A. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics. 1988. 16p. Order Number DE89618915/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Submitted to Yad. Fiz.

The electric α_π and magnetic β_π polarizabilities are calculated in the Quark Confinement Model (QCM). The diagrams with vector, scalar and axial intermediate states are taken into account. It is found that intermediate scalar mesons give an essential contribution to electric and magnetic polarizabilities of pions. The following values for α_π and β_π are obtained: $\alpha_{\pi(\pm)}=4.06\text{x}10^{-43}$ cm^3; $\beta_{\pi(\sup\pm)}=-3.84\text{x}10^{-43}$; $\alpha_{\pi(\sup 0)}=-0.18\text{x}10^{-43}$ cm^3; $\beta_{\pi(\sup 0)}=1.92\text{x}10^{-43}$ cm^3. The widths of strong ($\alpha_0(980)$ -> πeta, $f_0(975)$ -> $\pi\pi$, $\epsilon(730)$ -> $\pi\pi$) and radiative ($\alpha_0(980)$, $f_0(980)$, $\epsilon(730)$ -> $\gamma\gamma$) decays are calculated. The results are obtained to be in satisfactory agreement with expermental data. 19 refs,; 8 figs.; 4 tabs.

34980 (JINR-E–4-88-610) **Three-dimensional relativistic equations for $\pi\pi$, πN and NN scattering.** Machavariani, A.I. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics. 1988. 12p. Order Number DE89618916/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Different Low-type equations for the $\pi\pi$, πN and NN scattering t-matrices are considered. Their connection with the Lippmann-Schwinger equation with the relativistic kinematics is analyzed and the comparison with the corresponding quasipotential equations is made. 16 refs.

34981 (JINR-R–1-88-327) **Analysis of inclusive characteristics of hadron interactions from 4 to 360 GeV/c momentum by the Lund model.** Batyunya, B.V.; Grishin, V.G.; Didenko, L.A.; Grishina, O.V.; Metreveli, Z.V. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy. 1988. 18p. (In Russian). Order Number DE89618917/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Submitted to the journal Yad. Fiz.

Data on the inclusive characteristics of secondary particles produced in soft p-barp-, pp- and π^-p interactions over 4 to 360 GeV/c momentum range have been analyzed in the framework of the Lund model (LM) which considers these collisions as a result of parton interaction (quark and gluons). The results obtained with large bubble hydrogen and propane bubble chamber at the Dubna and Serpukhov accelerators and the results for other energies were used in the analysis. The comparison of the calculated results with the data on the multiplicity, cross sections and inclusive momentum characteristics of secondary particles shows that a part of data from 4 to

360 GeV/c is satisfactorily described by the LM. The regions of the LM applicability in the used versions for soft π^-p and pp interactions in this energy region have been obtained. 18 refs.; 13 figs.; 4 tabs.

34982 (JINR-R–2-88-364) **Additional Z'-boson in ν-barN elastic and quasielastic scattering.** Bednyakov, V.A.; Kovalenko, S.G. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems. 1988. 10p. (In Russian). Order Number DE89618895/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Submitted to the journal Phys. Lett., B.

Contribution of an extra Z'-boson to the elastic ν-barp scattering, π^0 neutrino-production on nuclei and some diffractive reactions is calculated in the frame of superstring inspired E_6-model. We give quantitative estimations of this contribution and its dependence on model parameters. 11 refs.; 4 figs.; 1 tab.

34983 (JINR-R–2-88-501) **On the value of isolated dibaryon resonance decay width.** Bazhanskij, I.I.; Reznik, B.L.; Luk'yanov, V.K.; Titov, A.I. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics. 1988. 18p. (In Russian). Order Number DE89618918/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Width of decay Γ of isolated dibaryon into nucleon-nucleon channel is calculated. Dependence of Γ on basic parameters determining the dynamics of interaction in multiquark systems is investigated. It is shown that its magnitude for typical values of these parameters is limited: $\Gamma<=40$ MeV. 18 refs.; 1 fig.

34984 (JINR-R–2-88-556) **Approximation of hadron interactions by Regge diagrams with multipomeron exchange.** Barashenkov, V.S. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation. 1988. 6p. (In Russian). Order Number DE89618919/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

A good agreement of hadron diffraction interaction total cross section and their elastic scattering at small angles calculated by summarizing Regge multipomeron exchange diagrams with experiment mentioned by a number of authors results from the fitting of a great variety of the parameters contained in the formulas. The agreement of the other hadron characteristcs with experiment is worse. Distribution of hadron interactions over the number of fragmenting quark-gluon strings calculated by utilizing Regge diagrams is discussed. 10 refs.; 2 figs.; 3 tabs.

34985 (KEK–88-3, pp. 25-35) **DEMON and high energy theory.** Lim, Chong-Sa (National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan)). National Lab. for High Energy Physics, Oho, Ibaraki (Japan). Jun 1988. (CONF-8803216–: 1. KEK symposium on ultra cold neutrons (UCN), Tsukuba, Japan, 10 Mar 1988). In *1st KEK symposium on ultra cold neutrons (UCN)*. Order Number DE89012146/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

A study is carried out to examine several appealing gauge models to accomodate CP violation. There are two sources of DEMON (dipole electric moment of neutron): so-called theta vacuum of QCD, and CP violating weak interaction. The presence of the first source is rather suprising since it is usually considered that the strong interaction, which is well described by QCD, conserves T and CP exactly. Investigation is made of these issues. Another investigation is made of DEMON due to Weak CP violation. It is found that the models examined predict quite different values of the coupling constant (DEMON). In particular, the most popular standard model by Kobayashi and Maskawa seems to give a value of the constant far below the present upper bound. It is interesting to note that both the left-right symmetric and spontaneous CP violation models have the tendency to predict values of the constant not so far from the experimental bound. The spontaneous CP violation model, in particular, appears to be the most promising candidate to give a value of the constant very close to the upper bound. Thus, the improvement of upper bound or measurement of DEMON by ultra cold neutron experiments is very desirable and will shed much light on the mechanism of CP violation. (N.K.).

34986 (KEK–88-3, pp. 111-129) **Ultra-cold anti-neutrons (UCN-bar).** Golub, R. (National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan)); Yoshiki, H. National Lab. for High Energy Physics, Oho, Ibaraki (Japan). Jun 1988. (CONF-8803216–: 1. KEK symposium on ultra cold neutrons (UCN), Tsukuba, Japan, 10 Mar 1988). In *1st KEK symposium on ultra cold neutrons (UCN)*. Order Number DE89012146/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

Since the suggestion of Mohapatra and Marshak concerning the possibility of n-n-bar oscillations there has been a growing interest in the experimental observation of such oscillations in free neutrons. The neutron is in fact a neutron-antineutron two particle system according to this interpretation. The idea of carrying out such a search using ultra-cold neutrons (UCN) has been rejected by most workers in this field because of the phase shifts and associated loss of coherence of the n-bar-wave function as a result of collisions with the walls of the UCN container. However one of the present authors has pointed out that it would be possible to compensate the n-bar-n relative phase shift caused by wall collisions with an opposite phase shift produced by an external magnetic field if coherence could be maintained. In the present work, theoretical consideration is made of a system which is free but under a magnetic field, assuming that δm is the $\Delta B = 2$ transition mass where B is the barionic number. Reflection of the system from a wall is analyzed. Two model potentials are used to give some idea of the sensitivity of the results to the shape of the n-bar-nucleus potential. It may be possible eventually to use observation of UCN to obtain a high precision determination of the n-bar-matter interaction. (N.K.).

34987 (LBL–26669) **Teachers' resource book on fundamental particles and interactions.** Quinn, H.R.; Dorfan, J.; Barnett, R.M.; Cahn, R.N.; Goldhaber, G.; Aubrecht, G.J. II. Lawrence Berkeley Lab., CA (USA). c 31 Jan 1989. 144p. Sponsored by DOE Energy Research. DOE Contract AC03-76SF00098;AC03-76SF00515. PHY83-18358. Order Number DE89013418/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

People have long asked "What is the world made of?" and "What holds it together?" Particle physics seeks to answer these questions. Over the past ten years a clear consensus has evolved. Down to the smallest scales studied experimentally, these questions are answered by a theory that particle physicists call "the Standard Model." The purpose of this book is to summarize this theory in a form suitable for presentation to beginning physics students.

34988 (LU-TP–88-5) **ARIADNE - A Monte Carlo for QCD cascades in the colour dipole formulation.** Pettersson, U. Lund Univ. (Sweden). Dept. of Theoretical Physics. Apr 1988. 14p. Order Number DE89618922/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

We present a Monte Carlo program for generating QCD cascades, based on the colour dipole approximation. In this formulation the gluons are radiated from dipoles that are stretched from one colour charge to the corresponding anti-charge. The subsequent emission of gluons thus corresponds to the dipoles being split into smaller and smaller dipoles. This formulation automatically takes into account the angular ordering and the ordering in transverse momenta, and it also gives some nontrivial azimuthal effects.

34989 (LU-TP–88-14) **Coherence effects in deep inelastic scattering.** Andersson, B.; Gustafson, G.; Loennblad, L.; Pettersson, U. Lund Univ. (Sweden). Dept. of Theoretical Physics. Sep 1988. 26p. Order Number DE89618920/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

We present a framework for deep inelastic scattering, with bound state properties in accordance with a QCD force field acting like a vortex line in a colour superconducting vacuum, which implies some simple coherence effects. Within this scheme one may describe the results of present energies very well, but one obtains an appreciable depletion of gluon radiation in the HERA energy regime. (authors).

34990 (LU-TP–88-15) **ARIADNE 2. A Monte Carlo for QCD cascades in the colour dipole formulation. An update.** Loennblad, L.; Pettersson, U. Lund Univ. (Sweden). Dept. of Theoretical Physics. Sep 1988. 15p. Order Number DE89618921/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

We present a Monte Carlo program for generating QCD cascades, based on the colour dipole approximation. This version is an extension of the program ARIADNE. A parton cascade is generated

by emitting gluons from colour dipoles that are stretched from a colour charge to the corresponding anti-charge. New features include option for strict ordering in transverse momenta, different choices of giving recoils to the colour charges and supression of radiation from dipoles with extended colour fields (relevant to deep inelastic scattering). (authors).

34991 (USIP–88-04) **Hilbert space of closed bosonic string.** Nilsson, M. Stockholm Univ. (Sweden). Inst. of Physics. Mar 1988. 29p. Order Number DE89617825/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

We know from the bosonic particle that the Hilbert space comes from the quantized constraints. The constraints lead to a field equation defined on spacetime. For a string the constraints will be functional equations after quantization. We reduce the Hilbert space of the closed bosonic string to that of a field theory defined on spacetime. Using the mode expansion the dependence of the Fourier components with mode number different from zero can be solved for and extracted from the dependence of the zero mode. The zero mode can be indentified with spacetime. With mode expansion and standard unification of constraints we arrive at two sets of Virasoro conditions. Treating these conditions as a sum of differential operators we reduce the two sets of Virasoro conditions to two sets of differential equations. Discussing the properties of the solutions to these equations we show that the two set of Virasoro conditions can be reduced to a set of field equations for the spacetime mode. We derive all the field equations, thus we reduce the Hilbert space of the closed bosonic string to that of a field theory defined on spacetime. Thus we arrive at a string field theory. We also see that the field equations automatically relate fields of the same mass.

34992 **Inelastic lepton-deuteron scattering: Possible coherent effects.** Yen, G. D. (Physics Department, Iowa State University, Ames, Iowa 50011(US)); Vary, J. P. *Physical Review [Section] C: Nuclear Physics (USA),* 40(1): 16-18 (Jul 1989).

Electron-deuteron data exhibit some unusual secondary peaks in the plots of νW_2 versus Bjorken x. It is our spectulation that these peaks are evidence of interference between three-quark and the six-quarkcluster contributions to the inclusive data.

34993 **Diquark production in ep collisions.** Rizzo, T.G. (Ames Lab., IA (USA)). *Zeitschrift fuer Physik [Sektion] C: Particles and Fields (F.R. Germany),* 43(2): 223-227 (Jun 1989). DOE Contract W-7405-ENG-82.

We examine the production of single diquarks (D) and diquark pairs (Danti D) in ep collisions using the effective photon approximation. Cross-sections for both mechanisms are found to be quite sensitive to the assumed charges of the diquark but can lead to significant production rates in all cases at HERA and future ep colliders. Backgrounds from QCD jet production are found to be potentially significant in the case of single D production where the signal to background is approximately one-to-one whereas the production of Danti D pairs is relatively background free.

34994 **Observations in particle physics from two neutrinos to the Standard Model.** Lederman, L. M. (The Fermi National Accelerator Laboratory, Batavia, Illinois 60510(US)). *Reviews of Modern Physics (USA),* 61(3): 547-560 (Jul 1989).

The lecture delivered on the presentation of the 1988 Nobel Prize in Physics is reprinted. The author describes the development of the standard Model of elementary particles through a series of experiments studying leptons. (AIP)

34995 **Heavy top-quark mass predictions.** Marciano, W. J. (Brookhaven National Laboratory, Upton, New York 11973(US)). *Physical Review Letters (USA),* 62(24): 2793-2796 (12 Jun 1989). DOE Contract AC02-76CH00016.

Renormalization-group equations and asymptotic conditions are used to obtain top-quark mass predictions. In the standard model with an explicit Higgs mechanism, our analysis becomes identical to the Kubo-Sibold-Zimmermann coupling-reduction approach. Refining their prediction, we find $m_t \cong 95$ GeV. In the simplest case of self-consistent dynamical symmetry breaking, we obtain $m_t \cong 115$ GeV. An illustration of how short-distance new physics can alter these predictions is given.

34996 **Annihilation of heavy-neutral-fermion pairs into monochromatic γ rays and its astrophysical implications.** Rudaz, S. (School of Physics and Astronomy, University of Minnesota, Minneapolis, Minnesota 55455(US)). *Physical Review [Section] D: Particles and Fields (USA),* 39(12): 3549-3556 (15 Jun 1989).

We present estimates for the rates of the processes $\chi\chi \to \gamma\gamma$ and $\chi\chi \to V\gamma$, where χ is a heavy-neutral-fermion candidatefor galactic cold dark matter and V is a vector quarkonium state $J/\psi(3097)$ or $\Upsilon(9460)$. A discrepancy with a previous estimate of the rate of the photino pair annihilation process $\tilde{\gamma}\tilde{\gamma} \to \gamma\gamma$ is uncovered and its origin discussed. We explorethe possibility that some of the processes considered may be astrophysicallysignificant sources of monochromatic γ-ray lines, in the energy rangeof a few to a few tens of GeV, for which theoretical estimates of thebackground γ-ray flux are unfortunately subject to large uncertainties.

6453 Particle Invariance Principles and Symmetries

Refer also to citation(s) 35028, 35030, 35373, 35374, 35375, 35376, 35377, 35378, 35379, 35380, 35383, 35384, 35385

34997 (IFUSP-P–731) **Classical solutions of a nonrelativistic model exhibiting spontaneous symmetry breakdown.** Spehler, D.; Marques, G.C. Sao Paulo Univ., SP (Brazil). Inst. de Fisica. Aug 1988. 27p. Order Number DE89618506/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The inverse scattering method is used in order to get solutions of a nonrelativistic and nonlinear model exhibiting spontaneous breakdown of symmetry. Explicit expressions for multiple soliton solutions were developed. The one soliton solution exhibits some interesting properties. In particular, they interpolate between two different vacua of the theory differing by a phase which is related to the soliton velocity.

34998 (IFUSP-P–739) **Local bosonic symmetries in the string's action.** Gamboa, J. Sao Paulo Univ., SP (Brazil). Inst. de Fisica. Sep 1988. 6p. Order Number DE89618507/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

The string action enjoys Sierra's bosonic local symmetry on which Siegel's k-symmetry closes. This bosonic symmetry is analyzed in Dirac's Hamiltonian formalism and its generators are identified.

34999 (INIS-SU–90) **Introduction to Moufang symmetry.** Paal, Eh.N. AN Ehstonskoj SSR, Tallin (USSR). 1987. 59p. (In Russian). Order Number DE89618508/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

In the present paper, the differential equations of a local analytical (l.a.) Moufang loop are established which turn out to be a natural generalization of the Lie and Maurer-Cartan equations from the Lie groups theory. By using the triality-property of the generalized Maurer-Cartan equations the Sagle-Yamaguti identity (equivalent to the Malcev one) is proved to hold in the tengent space T_e of the identity element e of the l.a. Moufang loop. Also, the commutation relations of the most important Lie algebras associated with a given l.a. Moufang loop are established. Preprint F–42; 41 refs.

35000 (INS–720) **Hosotani model in closed string theory.** Shiraishi, Kiyoshi. Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study. Nov 1988. 33p. Order Number DE89778086/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Hosotani mechanism in the closed string theory with current algebra symmetry is described by the (old covariant) operator method. We compare the gauge symmetry breaking mechanism in a string theory which has SU(2) symmetry with the one in an equivalent compactified closed string theory. We also investigate the difference between Hosotani mechanism and Higgs mechanism in closed string theories by calculation of a fourpoint amplitude of 'Higgs' bosons at tree level.

35001 (JINR-R–2-88-544) **Integrable three-channel static model for the scattering of two particles with spin 1.** Rerikh, K.V. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics. 1988. 28p. (In Russian). Order Number DE89618509/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Submitted to the journal Mat. Sb.

Equations of the static model with the crossing symmetry matrix A(1,1) in their famous formulation as a system of nonlinear difference equations are investigated. The geometric interpretation of these equations as quadratic Cremona transformations is given. Using the properties of the latter the functional equation on the invariant algebraic curves is obtained, the investigation of which enables one to find three invariant algebraic curves and to assert that except for them only the invariant nonalgebraic curve possibly exists. Using invariant polynomials found the quadratic Cremona transformation is constructed, which transforms the initial equations to a very simple form, which enables one to find an invariant nonalgebraic curve and to investigate its properties. These equations interpreted as the mapping with a fixed hyperbolic point have the Jacobian not equal one. The invariant measure and the Cremona transformation casting these equations into the form of area-preserving mapping are found. Using the results of Birkhoff and Moser for the mapping the outhers transform the initial difference equations into an easily integrable form. Two types of the general solution for the initial equations are obtained. 26 refs.; 3 figs.

35002 (LAPP-TH–217-88) **Unitarity polygons and CP violation areas and phases in the standard electroweak model.** Jarlskog, C.; Stora, R. Grenoble-1 Univ., 74 - Annecy (France). Lab. de Physique des Particules. Apr 1988. 17p. Order Number DE89781485/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

A geometrical interpretation of CP violation in terms of areas of unitarity triangles is presented, in the Standard Electroweak Model with three families of quarks. The extension of the results to the case of four families is investigated. A special case is worked out in detail where it is shown how one determines the CP violating invariant phases and the areas of the CP violation triangles as functions of the moduli of the elements of the quark mixing matrix. For the most general four family case, which is found to be rather involved, the necessary formulae, for determining the invariant phases and the CP violation areas, are given.

6454 Field Theory

Refer also to citation(s) 34875, 34961, 35264, 35266, 35267, 35344, 35371

35003 (ANL-HEP-PR–87-54) **Noether's therorem for local gauge transformations.** Karatas, D.L.; Kowalski, K.L. Argonne National Lab., IL (USA). 22 May 1989. 23p. Sponsored by DOE Energy Research. DOE Contract W-31109-ENG-38. Order Number DE89013674/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The variational methods of classical field theory may be applied to any theory with an action which is invariant under local gauge transformations. What is the significance of the resulting Noether current? This paper examines such currents for both Abelian and non-Abelian gauge theories and provides an explanation for their form and limited range of physical significance on a level accessible to those with a basic knowledge of classical field theory. Several of the more subtle aspects encountered in the application of the residual local gauge symmetry found by Becchi, Rouet, Stora, and Tyutin are also considered in detail in a self-contained manner. 23 refs.

35004 (CBPF-NF–057/88) **SU(4) properties of the Dirac equation.** Linhares, C.A.; Mignaco, J.A. Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro, RJ (Brazil). 1988. 32p. Order Number DE89618458/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The Dirac equation in four dimensions has an intimate connection with the representations of the group SU(4). This connection is shown in detail and subsequente properties are displayed in the continuum as well as in the lattice description.

35005 (IC–89/5) **Study of W-boson in a magnetic field based upon both mass operator and effective potential.** Skalozub, V.V.; Vanyashin, V.S. International Centre for Theoretical Physics, Trieste (Italy). Jan 1989. 16p. Order Number DE89618461/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A review of W-boson properties in a constant magnetic field is given. The one-loop radiative corrections to the W-boson mass operator and to the effective potential are taken into account simultaneously. The external field mass-shell equation and the Lorentz condition, which follows from it, has also been considered with radiation effects included. The mass operator on the mass-shell in the weak and critical field limits is found and discussed. The critical field tachyon problem is invesigated with regard to the radiative corrections. It is argued that the consistent treatment of the W-boson in an external magnetic field crucially depends upon the value of the Higgs particle mass. The self-consistency argument, related to the zero-charge situation in the critical field region, leads to an upper bound on the Higgs mass approximately equal to 260 GeV. (author). 37 refs.

35006 (IC–89/9) **Effective actions for gauge theories with Chern-Simons terms - I.** Bambah, B.A.; Mukku, C. International Centre for Theoretical Physics, Trieste (Italy). Jan 1989. 22p. Order Number DE89618462/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The effective Lagrangian for a three-dimensional gauge theory with a Chern-Simons term is evaluated upto one-loop effects. It is shown to be completely finite. It also does not exhibit any imaginary part. The calculation is carried out in a background field analogue of the Feynman gauge and gauge invariance is maintained throughout the calculation. In an appendix an argument is presented as to why this Feynman gauge may be a 'good' gauge for our results to be applied to high temperature QCD and in particular to the quark-gluon plasma. (author). 12 refs.

35007 (IC–89/38) **Superfiled formulation of Chern-Simons supersymmetry.** Birmingham, D.; Rakowski, M. International Centre for Theoretical Physics, Trieste (Italy). Mar 1989. 10p. Order Number DE89618459/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

We discuss an extra supersymmetry present in the covariantly quantized Chern-Simons action within the superfield formalism. By introducing scalar superfields we show how the component transformations are naturally reproduced from the superfield transformation. When the superspace is extended to include an additional odd coordinate for the BRST symmetry, the entire theory is described by a single odd scalar superfield. The implications of this supersymmetry for the renormalized theory are also discussed. (author). 9 refs.

35008 (IC–89/47) **General action for topological quantum field theories.** Dayi, O.F. International Centre for Theoretical Physics, Trieste (Italy). Mar 1989. 18p. Order Number DE89618460/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Topological field theories can be formulated by beginning from a higher dimensional action. The additional dimension is an unphysical time parameter and the action is the derivative of a functional W with respect to this variable. In the d = 4 case, it produces actions which are shown to give topological quantum field theory after gauge fixing. In d = 3 this action leads to the Hamiltonian, which yields the Floer groups if the additional parameter is treated as physical when W is the pure Chern-Simons action. This W can be used to define a topological quantum field theory in d = 3 by treating the additional parameter as unphysical. The BFV-BRST operator quantization of this theory yields to an enlarged system which has only first class constraints. This is not identical to the previously introduced d = 3 topological quantum field theory, even if it is shown that the latter theory also gives the theory which we began with, after a partial gauge fixing. (author). 18 refs.

35009 (IFUSP-P–741) **Spin and paramagnetism in classical stochastic electrodynamics (SED).** Barranco, A.V.; Brunini, S.A.; Franca, H.M. Sao Paulo Univ., SP (Brazil). Inst. de Fisica. Sep 1988. 31p. Order Number DE89618463/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The statistical properties of the spin $S^{->}$ and magnetic dipole μ^{-} of a particle with two constituents bounded by a harmonic force are studied. The relation between $\mu^{->}$ and $S^{->}$ and also conclude that $< S^{->2} >$ ~ Planck constant^2 is found. The giromagnetic factor can assume any value depending on the charges and masses of the constituents. In another example, the case of a permanent magnetic dipole moving in an external magnetic field, under the

influence of the fluctuations associated with the zero-point and thermal radiations characteristic of SED is considered. It is concluded that the system presents paramagnetism and comparison with the experimental data shows excellent agreement with SED.

35010 (IFUSP-P–746) **On the λ 'phi'^{4} - O(N) model at finite temperature.** Silva, A.J. da. Sao Paulo Univ., SP (Brazil). Inst. de Fisica. Nov 1988. 19p. Order Number DE89618464/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The λPHI^4-O(N) model is analyzed, in the leading 1/N approximation at finite temperature, with the conclusion that it is unstable above a certain temperature. The different scaling of the effective coupling of the effective coupling constant in p^2 and T, and the behavior of the mass and of the bound state with T is also discussed.

35011 (IFUSP-P–757) **Numerical simulations of the O(3) and CP^1 models using the Langevin equations and the Metropolis algorithm.** Abdalla, E.; Abdalla, M.C.B.; Alves, N.A.; Carneiro, C.E.I. Sao Paulo Univ., SP (Brazil). Inst. de Fisica. Dec 1988. 47p. Order Number DE89618465/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The O(3) model, the pure CP^1 model and the CP^1 model minimally coupled to fermions are numerically simulated. The equivalence between the O(3) and the bound state of the pure CP^1 model is investigated. It is shown that: the relations $g_{O(3)} = 2\ g_{CP(sup1)}$ and $E_{O(3)} = 2E_{CP(sup1)} + 2$, for the coupling constants and energies hold beyond the classical level; the mass gap as a function of the coupling is the same for both models. The mass gap for the CP^1 minimally coupled to fermions is also calculated. The calculations are performed using different techniques. The proposal by Namiki and colaborators to enforce constraints on Langevin equations and Parisi's technique to calculate correlation functions via Langevin equations is tested. The results are compared with those obtained using the multi-hit Metropolis algorithm.

35012 (INIS-BR–1483, pp. 53) **Electronic structure of semiconductors of group IV and III-V compounds calculated by the self consistent variational cellular method.** Takahashi, E.K. (Uberlandia Univ., MG (Brazil). Dept. de Fisica); Ferraz, A.C.; Leite, J.R. Minas Gerais Univ., Belo Horizonte (Brazil). Dept. de Fisica. 1989. (CONF-8901126–: 4. Brazilian school of semiconductor physics, Belo Horizonte, Brazil, 23 Jan - 3 feb 1989). In *Proceedings of the 4. Brazilian School of Semiconductor Physics.* Order Number DE89612194/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

SELF-CONSISTENT FIELD/electronic structure; SELF-CONSISTENT FIELD/semiconductor materials; SELF-CONSISTENT FIELD/variational methods; BORON NITRIDES; BORON PHOSPHIDES; CHARGE DENSITY; MUFFIN-TIN POTENTIAL; SILICON

35013 (IPNO-TH–87-81) **Particle-particle and hole-hole RPA correlations at finite temperature and the temperature dependence of the level density parameter.** Vinh Mau, N. Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire. Nov 1987. 30p. Order Number DE89781493/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The pp-hh RPA equations obtained by summing the infinite series of ladder, upwards and backwards going diagrams in the temperature two particle Green's functions are derived at finite temperature. The contribution to the thermodynamic grand potential due to pp-hh RPA correlations is calculated simultaneously to that of ph RPA correlations. A schematic model is constructed which shows that, as for ph RPA states, the energies of pp and hh RPA states have no temperature dependence at not too high temperature. Within the same model, the temperature dependence of the level density parameter is discussed.

35014 (JINR-E–2-88-421) **On thermodynamic properties of chromoplasma.** Mitryushkin, V.K.; Zadorozhnyj, A.M.; Zinov'ev, G.M. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics. 1988. 8p. Order Number DE89618466/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Submitted to the journal Phys. Lett., B.

The contributions of electric and magnetic modes to some thermodynamic functions in SU(2)-gauge theory on the lattice $4x12^3$ were calculated. It is shown that the behaviour of the chromoelectric part of energy E_E can be interpreted within the Ising-type model in agreement with the universality hypothesis. At the same time the behaviour of the magnetic parts of the internal energy and pressure (i.e. E_M and P_M) differs drastically from that of E_E and P_E. The character of the temperature dependence of E_M and P_M exhibited here testifies to the presence of a highly nonidentical properties of electric and magnetic modes of chromoplasma and maybe sheds light on the role of unstable modes in gauge theories. 24 refs.; 3 figs.

35015 (JINR-E–2-88-474) **On sigma model formulation of Green-Schwarz superstring.** Isaev, A.P.; Ivanov, E.A. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics. 1988. 10p. Order Number DE89618467/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Submitted to the journal Modern Phys. Lett., A.

The Green-Schwarz covariant superstring action is consistently deduced as the action of the Wess-Zumino-Witten σ-model defined on the direct product of two N=1, D=10 Poincare supertranslation groups. N=2 supersymmetry of the action is shown to be related to a specific choice of the target manifold. We propose a zero curvative representation for the GS superstring field equations and interpret the local fermionic supersymmetry of the GS action as a gauge symmetry preserving this representation. 12 refs.

35016 (JINR-E–2-88-643) **Unification of a potential model with chiral Lagrangians.** Pervushin, V.N.; Kallies, W.; Kuranov, B.N.; Sarikov, N.A.; Kalinovskij, Yu.L. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics. 1988. 20p. Order Number DE89618468/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Submitted to Z. Phys., C.

A new approach to relativization of the potential model, which allows one to describe the spectra of light and heavy mesons and their interaction, is proposed. This approach is based on application of the principles of "minimal" quantization of the gauge theories (with explicit solutions of the Gauss equation) and choice of the quantization axis (by setting one parallel to the vector of differential with respect to the total bound state coordinate) which are used in QED for describing the relativistic atoms. We have obtained the Dyson-Schwinger equation describing the spectrum of quarks and generation of their dynamical masses and derived a new relativistic covariant form for the Salpeter equation for light and heavy meson spectra. To describe the interactions of mesons we have proposed to use the S-matrix formalism with the asymptotical states of quarkonia which are the solutions to the Salpeter equation. It is shown that the relevant in the limit of a small transfer momentum bilocal Lagrangian of the interactions (in the colourless channel), for light mesons, tends to the phenomenological chiral Lagrangians, and, for heavy mesons, it corresponds to the QED Lagrangian for interacting atoms. 21 refs.; 1 fig.

35017 (JINR-E–2-88-655) **Non-perturbative field theory/field theory on a lattice.** Ambjorn, J. Joint Inst. for Nuclear Research, Dubna (USSR). 1988. 42p. Order Number DE89618469/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The connection between the theory of critical phenomena in statistical mechanics and the renormalization of field theory is briefly outlined. The way of using this connection is described to get information about non-perturbative quantities in QCD and about more intelligent ways of doing the Monte Carlo (MC) simulations. The (MC) method is shown to be a viable one in high energy physics, but it is not a good substitute for an analytic understanding. MC-methods will be very valuable both for getting out hard numbers and for testing the correctness of new ideas. 33 refs.; 11 figs.

35018 (LAPP-TH–210-88) **On the construction of convex effective potentials at zero and finite temperature.** Eliashvili, M. Grenoble-1 Univ., 74 - Annecy (France). Lab. de Physique des Particules. Feb 1988. 9p. Order Number DE89781486/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

It is argued that the convexity property imposed on the effective potential can be satisfied only with a precise specification of the boundary conditions in the functional integral representation of the generating functionals. A procedure is established which leads to convex effective potentials at zero and finite temperatures.

35019 (LAPP-TH–221-88) **On infrared and mass singularities of perturbative QCD in a quark-gluon plasma.** Altherr, T.; Aurenche, P.; Becherrawy, T. Grenoble-1 Univ., 74 - Annecy (France). Lab. de Physique des Particules. Jul 1988. 33p. Order Number DE89781487/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

We discuss the radiative corrections to the production of lepton pairs in a quark-gluon plasma at finite temperature. The real-time formalism is used throughout the calculations. We show that both infrared and mass singularities cancel in the final result. In contrast to the zero-temperature case, no factorization theorem is required to deal with mass singularities.

35020 (LYCEN–8767) **Wigner - Kirkwood Planck constant - expansion of the linear response function.** Chanfray, G.; Schuck, P. Lyon-1 Univ., 69 - Villeurbanne (France). Inst. de Physique Nucleaire. Dec 1987. 30p. Order Number DE89781497/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

For the treatment of inhomogeneous Fermi systems we derive a semi-classical expansion of the linear response function in powers of Planck constant (up to Square Planck constant) for the interacting (RPA) and non-interacting (Lindhardt function) case. We find that the series is rapidly converging and that the semi-classical result compares very well with exact model calculations for cases where the response does not exhibit narrow resonances (e.g. the quasielastic peak region) otherwise it still represents the average value.

35021 (NBI-HE–89-18) **Fermionized spin systems and the boson-fermion mapping in 2+1 dimensional gauge theory.** Ambjoern, J.; Semenoff, G.W. Niels Bohr Inst., Copenhagen (Denmark); British Columbia Univ., Vancouver, BC (Canada). Dept. of Physics. 1989. 12p. Order Number DE89783577/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

A generalization of the Jordan-Wigner transformation is used to present 2 dimensional quantum spin systems with s=1/2 as particular lattice gauge theories with spinless Fermionic variables. It is argued that for magnetically ordered phases the large wavelength limit produces a concrete physical realization of continuum topologically massive electrodynamics in 2+1 dimensions with Fermionic matter. We also give an explicit example of transmutation from Fermi to Bose statistics in 2+1 dimensional gauge theory with a Chern-Simons term.

35022 (NBI-HE–89-19) **Vortices and the phase structure of the multiply-charged U(1) Higgs model.** Damgaard, P.H.; Heller, U.M. Niels Bohr Inst., Copenhagen (Denmark); California Univ., Santa Barbara, CA (USA). Inst. for Theoretical Physics. Mar 1989. 16p. (FSU-SCRI–89-39). Order Number DE89783578/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

We discuss the phase diagram for the U(1) Higgs model with a variable-length Higgs field of charge Qnot =1. Monte Carlo methods are used to map out in detail the phase structure for Q=2 and 6, and for selected values of the scalar self-coupling λ. When an external electromagnetic field is coupled to this model we observe the appearance of a vortex populated type-II phase, as well as a region with magnetic flux expulsion.

35023 Embedding and breaking of gauge symmetries. Baluni, V. (Stanford Linear Accelerator Center, CA (USA)). *Physics Letters [Section] B (Netherlands),* 222(1): 103-109 (11 May 1989). DOE Contract AC03-76SF00515.

The effective potential of "weak" interactions of a gauge group R is studied in the framework of models whose global symmetry group G is dynamically broken down to its subgroup H. The properties of its critical points on the double coset Rinverse slantG/H and their dependence on the embeddings Ris contained inG, His contained inG are investigated. All critical points with a nontrivial residual gauge symmetry H_w=RintersectionH are identified in the series of models SU(n)inverse slantSU(N)/SO(N), n<N≤6 and SU(n)inverse slantSU(2N)/Sp(N), n<2N≤6 with n=2, 3. Examples of degenerate hessians i.e. potentials with flat directions both neutral and charged under H_w are presented and their physical implications are briefly discussed.

35024 String field theory on the conformal plane. Pt. 1. Kinematical principles. Leclair, A. (Harvard Univ., Cambridge, MA (USA). Jefferson Lab. of Physics); Peskin, M.E.; Preitschopf, C.R. *Nuclear Physics [Section] B (Netherlands),* 317(2): 411-463 (1 May 1989). DOE Contract AC03-76SF00515.

We formulate string field theory geometrically by writing each term in the field theory action as an expectation value in the 2-dimensional conformal field theory on the world surface. We show how the symmetries of the theory can be analyzed and the gauge invariance demonstrated from this point of view. As an application, we give a complete proof of the gauge invariance of Witten's open string field theory.

35025 String field theory on the conformal plane. Pt. 2. Generalized gluing. Leclair, A. (Harvard Univ., Cambridge, MA (USA). Jefferson Lab. of Physics); Peskin, M.E.; Preitschopf, C.R. *Nuclear Physics [Section] B (Netherlands),* 317(2): 464-508 (1 May 1989). DOE Contract AC03-76SF00515.

In our previous paper, we defined multistring vertices by conformally mapping string states onto the complex plane. In this paper, we prove the combination rules for these vertices. The contraction of two vertices by the natural inner product on the string Hilbert space yields just the composite vertex which would have been obtained by gluing together the two world sheets in an appropriate fashion.

35026 Gauge invariance in Chern-Simons theory on a torus. Hosotani, Y. (Institute for Advanced Study, Princeton, New Jersey 08540(US)). *Physical Review Letters (USA),* 62(24): 2785-2788 (12 Jun 1989).

In the Chern-Simons gauge theory on a manifold $T^2 \times R^1$ (two-torus x time) the unitary operators, which induce large gauge transformations shifting the nonintegrable phases of the two distinct Wilson-line integrals on the torus by multiples of 2π, do not commute with each other unless the coefficient of the Chern-Simons term is quantized. In U(1) theory this condition gives the statistics phase $\theta=\pi/n$ (n an integer). The condition coincides with the one previously derived on a manifold S^3 (three-sphere) for SU($N\geq3$) theory but differs by a factor 2 for SU(2) theory. The requirement of the Z_N invariance in pure SU(N) gauge theory imposes a stronger constraint.

35027 The δ expansion for stochastic quantization. Bender, C. M. (Department of Physics, Washington University, St. Louis, Missouri 63130(US)); Cooper, F.; Milton, K. A. *Physical Review [Section] D: Particles and Fields (USA),* 39(12): 3684-3689 (15 Jun 1989).

Using a recently proposed perturbation expansion called the δ expansion, we show how to solve the Langevin equation associated with a $g\phi^4$ field theory. We illustrate the technique in zero- and one-dimensional space-time, and then generalize this approach to d dimensions.

35028 Conformal properties of the superstring-ghost Thirring model: Short-distance structure and bosonization. Freedman, D. Z. (Department of Mathematics and Center for Theoretical Physics, Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139(US)); Gath, E.; Pilch, K. *Physical Review [Section] D: Particles and Fields (USA),* 39(12): 3703-3712 (15 Jun 1989).

It is known that the free theory of superstring-ghost fields can be extended by adding the superconformal-invariant quartic interaction QJJ^- where $J=bc+\beta\gamma$ is the total ghost number current. We use functional techniques to compute correlation functions of the elementary fields and currents of the theory to all orders in the coupling constant Q, and we use these to obtain the important operator products. The model is then shown to bosonize in terms of the same fields used for the free system, and we obtain bosonization formulas such as $c(z,z^-)=:\exp[a_1 c\phi_1(z) + a_2 c\phi_2(z) + b_1 c\tilde{\phi}_1(z^-) + b_2 c\tilde{\phi}_2(\bar{z})]:$, where a_i and b_i are algebraic functions of Q, such that a_2, b_1, and b_2 vanish in the free limit. The model thus exhibits the nonholomorphic behavior characteristic of the Thirring model as well as novel mixing of the scalar fields $c\phi_1$ and $c\phi_2$. It does not seem possible to construct an operator in the interacting theory with the properties of the Becchi-Rouet-Stora-Tyutin current.

35029 Genus-2 free energy of the closed bosonic string. Leblanc, Y. (Center for Theoretical Physics, Laboratory for Nuclear

Science dge, Massachusetts 02139(US)). *Physical Review [Section] D: Particles and Fields (USA),* 39(12): 3731-3744 (15 Jun 1989).

Making use of the recently developed real-time finite-temperature formalism for string theory, we obtain an explicit expression for the Helmholtz free energy of a closed-bosonic-string gas in the genus-2 approximation. Our computation takes advantage of the modern Becchi-Rouet-Stora-Tyutin-invariant operator formalism for multiloop amplitudes and can be readily extended to arbitrary genus. We find some disagreement with previous results obtained through the imaginary-time (compactification) technique extended to higher-genus Riemann surfaces. Our comparison with the imaginary-time formalism is based on the McClain-Roth theorem. We mention a possible remedy to the latter technique in order to get correct results.

35030 Effective one-loop Lagrangian for gauged *scrH/scrK* σ models. Gaillard, M. K. (Department of Physics, University of California and Theoretical Physics Group, Physics Division, Lawrence Berkeley Laboratory, 1 Cyclotron Road, Berkeley, California 94720(US)); Jain, V. *Physical Review [Section] D: Particles and Fields (USA),* 39(12): 3755-3765 (15 Jun 1989). DOE Contract AC03-76SF00098.

We determine the divergent one-loop contributions to the effective action for a gauged nonlinear σ model in which the scalars are valued on the coset space *scrH/scrK* of a noncompact group *scrH*, with *scrK* its maximally compact subgroup. We focus especially on the scalar+Yang-Mills sector of a class of no-scale supergravity models suggested by superstrings. The formalism developed should be applicable to a broader class (with compact or noncompact *scrH*) of interesting models.

65 PHYSICS II

6510 Nuclear Physics

Refer also to citation(s) 34945

35031 (INIS-mf–11456, pp. 427-430) **Nuclear physics experiments on the electrostatic accelerator of the Nuclear Centre.** Wilhelm, I. (Karlova Univ., Prague (Czechoslovakia). Fakulta Matematicko-Fyzikalni). Jednota Ceskoslovenskych Matematiku a Fyziku, Prague (Czechoslovakia). 1987. (In Czech). (CONF-8707217–: 9. conference of Czechoslovak physicists, Pardubice, Czechoslovakia, 6-10 Jul 1987). In *Ninth conference of Czechoslovak physicists. Part 1, 2.* Order Number DE89617602/JAW. Available from NTIS (US Sales Only), PC A22/MF A01 - OSTI; INIS.

Experiments are discussed carried out on the electrostatic accelerator AN-2500 of the Nuclear Centre of the Charles University in Prague. Basic research is oriented to the study of the spin dependence of nuclear forces of n-p scattering at low energies, on determining averaged effective neutron cross sections and on the study of the (p,gamma) reaction at low energies. Applied research is oriented to the analysis of the surface of solids and to the calibration of semiconductor detectors. (Z.J.). 3 figs., 4 refs.

35032 (INIS-SU–78, pp. 165) **Analysis of distributions of reduced s neutron resonance widths.** Knat'ko, V.A. (AN Belorusskoj SSR, Minsk (Byelorussian SSR). Inst. Fiziki); Shimanovich, E.A. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij. 1988. (In Russian). (CONF-870959–: 1. international conference on neutron physics, Kiev, USSR, 14-18 Sep 1987). In *Neutron physics. Vol. 2.* Order Number DE89012115/JAW. Available from NTIS (US Sales Only), PC A16/MF A01; INIS.

NEUTRON REACTIONS/s states; DISTRIBUTION FUNCTIONS; EIGENVECTORS; LEVEL WIDTHS; MATRICES

35033 (INIS-SU–78, pp. 165) **Systematics of radiative widths in the mass number range 40 < A < 250.** Bychkov, V.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (USSR). Fiziko-Ehnergeticheskij Inst.); Grudzevich, O.T.; Plyaskin, V.I. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij. 1988. (In Russian). (CONF-870959–: 1. international conference on neutron physics, Kiev, USSR, 14-18 Sep 1987). In *Neutron physics. Vol. 2.* Order Number DE89012115/JAW. Available from NTIS (US Sales Only), PC A16/MF A01; INIS.

HEAVY NUCLEI/level widths; INTERMEDIATE MASS NUCLEI/level widths; ENERGY-LEVEL TRANSITIONS; EXCITED STATES

35034 (INIS-SU–78, pp. 170-174) **Measurement of total neutron cross section and neutron spectrum of reactor in the energy range of 20-90 keV by means of sulfur filter.** Murzin, A.V. (AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij); Libman, V.A.; Litvinskij, L.L.; Lubchenko, N.A. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij. 1988. (In Russian). (CONF-870959–: 1. international conference on neutron physics, Kiev, USSR, 14-18 Sep 1987). In *Neutron physics. Vol. 2.* Order Number DE89012115/JAW. Available from NTIS (US Sales Only), PC A16/MF A01; INIS.

A new measurement method of total neutron cross sections σ_t and an atomic reactor neutron spectrum in 20-90 keV energy region by means of S filter was proposed. σ_t values of C, Si, S, Ti and ^{238}U have been measured. 4 refs.; 4 figs.

35035 (INIS-SU–78, pp. 288-292) **Monocrystalline Si, Ge, ^{74}Ge filters of thermal neutrons.** Vertebnyj, V.P. (AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij); Pshenichnyj, V.A.; Pak En Men. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij. 1988. (In Russian). (CONF-870959–: 1. international conference on neutron physics, Kiev, USSR, 14-18 Sep 1987). In *Neutron physics. Vol. 2.* Order Number DE89012115/JAW. Available from NTIS (US Sales Only), PC A16/MF A01; INIS.

Energy dependence of effective neutron cross-sections of Si, Ge, and ^{74}Ge monocrystals, the effect of the block structure of crystal and its orientation to the neutron beam on the cross-section are given in this paper. It is shown that the silicon crystal filter of thermal neutrons does not change its facility at the fluence of fast neutrons up to 10^{19} n/cm^2. 4 refs.; 2 figs.

35036 (INS–723) **Superconducting spectrometer for the study of hypernuclei via (π, K$^+$) reactions.** Hashimoto, O.; Nagae, T.; Shintomi, T. and others. Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study. Dec 1988. 14p. Order Number DE89778088/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

A superconducting kaon spectrometer (INS-SKS) is under construction at Institute for Nuclear Study, University of Tokyo. The spectrometer, with 1/1000 momentum resolution and 100 msr acceptance, has been designed for intensive study of hypernuclei via (π, K$^+$) reactions. It is to be installed in a new experimental hall of the KEK 12 GeV proton synchrotron and is scheduled to be ready for experiments by the end of 1990.

35037 (IPNO-TH–88-3) **Swelling of nucleons in nuclei and the Roper resonance.** Desplanques, B. Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire. Jan 1988. 16p. Order Number DE89781489/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Conditions where some swelling of the nucleon occurs, and, in particular the relation of this effect with the attractive character of the force acting on it, are studied. It is found that short range repulsive correlations can turn the swelling into a shrinking, in spite of a globally attractive interaction, whereas repulsive velocity dependent forces can lead to some swelling. The role of the Roper resonance in this nucleon change of size is considered in some detail.

35038 (JINR-E–7-88-650) **Observation of the new neutron-rich nuclei ^{29}F, ^{35,36}Mg, ^{38,39}Al, ^{40,41}Si, ^{43,44}P, ^{45,46,47}S, ^{46,47,48,49}Cl and ^{49,50,51}Ar by means of a 55 MeV/u ^{48}Ca beam.** Guillemaud-Mueller, D.; Anne, R.; Penionzhkevich, Yu.Eh. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions. 1988. 10p. Order Number DE89619054/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Using magnetic separation and identification through time of flight and ΔE,E measurements, the new neutron-rich nuclei, ^{29}F, ^{35,36}Mg, ^{38,39}Al, ^{40,41}Si, ^{43,44}P, ^{45,46,47}S, ^{46,47,48,49}Cl, ^{49,50,51}Ar have been observed from interactions of ^{48}Ca beam of 55 MeV/u with tantalum targets. 18 refs.; 5 figs.; 1 tab.

35039 (LBL–27144) **Fission throughout the periodic table.** Moretto, L.G.; Wozniak, G.J. Lawrence Berkeley Lab., CA (USA). Apr 1989. 18p. Sponsored by DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-890406–21: Fifty years with nuclear fission conference, Gaithersburg, Maryland, USA, 25-28 Apr 1989). Order Number DE89012990/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The dualistic view of fission and evaporation as two distinct compound nucleus processes is substituted with a unified view in which fission, complex fragment emission, and light particle evaporation are seen as different aspects of a single process. 47 refs., 22 figs.

35040 (ORNL/FTR–3266) **[US-Japan workshop on fusion neutronics at Osaka University, Osaka, Japan, May 25–26, and visits to Savar, Bangladesh, April 20–May 19, Beijing, China, May 21–24, and Tokai, Japan, May 29–30]: Foreign trip report.** White, J.E. Oak Ridge National Lab., TN (USA). 15 Jun 1989. 25p. Sponsored by DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89014731/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This trip was initiated by a request from IAEA for USA expert assistance in Bangladesh. The Bangladesh Atomic Energy Commission (BAEC) had acquired a 3MW TRIGA MARK-II research reactor and their specialist needed help in the development of computer codes and data for the effective utilization and analysis of their reactor. Nuclear data recognized as an international standard was installed on a BAEC computer at Savar. The traveler was invited to China (PRC) to discuss multigroup cross section processing methods used at ORNL. Also, the traveler participated in a US-Japan workshop on fusion neutronics at Osaka University where he discussed the activities of RSIC. An orientation visit to JAERI resulted in the collection of information of potential use in US DOE programs, a better understanding of their research activities, and an opportunity to develop personal relationships with JAERI staff.

6511 Experimental Techniques

35041 (IPNO-DRE–88-03) **Δ excitation by charge exchange reactions with heavy ions.** Boyard, J.L. Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire. Oct 1987. 9p. (CONF-8710373–: Riken-IN2P3 symposium on heavy-ion collisions, Shimoda, Japan, 11-15 Oct 1987). Order Number DE89781600/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

Δ excitation resonance is observed with heavy ions. It can be very strong in the two mirror charge exchange reactions. Δ excitation strength depends on the projectile ejectile system, on the target recoil nuclei and on the incident energy. The peak for the Δ in nuclei is energy shifted from the free Δ peak.

6512 Nuclear Properties and Reactions, A=1-5, Experimental

Refer also to citation(s) 34336

35042 (ANU-P–994) **Experimental investigations and R-matrix analysis of low-lying levels in ^{5}He and ^{5}Li.** Woods, C.L.; Barker, F.C.; Catford, W.N.; Fifield, L.K.; Orr, N.A. Australian National Univ., Canberra (Australia). Dept. of Nuclear Physics. Feb 1988. 39p. Order Number DE89619056/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The particle-unstable nuclei ^{5}He and ^{5}Li have been studied via the ^{4}He(^{7}Li, ^{6}Li)^{5}He and ^{4}He(^{7}Li, ^{6}He)^{5}Li stripping reactions at beam energies of 50 MeV and the ^{6}Li(^{12}C, ^{13}N) ^{5}Li pickup reactions at 90 MeV. The experimental data clearly demonstrate a dependence of the lineshapes on the method of production of the mass-5 nuclei (in this case pickup or stripping). The observed lineshapes were analysed using the R-matrix formalism in a two-level approximation for each J^{π} value, with parameter values deduced from fits to the available ^{4}He+nucleon scattering data. Properties of the lowest $3/2^-$ and $1/2^-$ states of ^{5}He and ^{5}Li, observed via direct reactions, are deduced from the parameter values. These properties; are compared with results from earlier experimental analyses and the inferred properties of positive-parity states are compared with the results of recent shell-model calculations.

35043 (CEA-CONF–9663) **Nucleons in nuclei (II).** Laget, J.M. CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physique Nucleaire. 1988. 21p. (CONF-8806236–: 1. European workshop on hadronic physics in the 1990's with multi-GeV electrons, Seillac, France, 27 Jun - 1 jul 1988). Order Number DE89781570/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

This summary is a review of our understanding of nuclei in terms of hadrons exchanging mesons. The open problems are: the determination of the high momentum components of nuclear systems, the role of the three-body forces and the nature of the short range correlations. The ways of studying these problems are discussed.

35044 (INS–724) **Reaction mechanism of ^{4}He(γ, pn)X at E_γ = 0.17 - 0.27 GeV.** Endo, I.; Harada, M.; Hisadomi, A. and others. Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study. Dec 1988. 17p. Order Number DE89778089/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

We measured the ^{4}He(γ, pn)X reaction for the first time in a wide kinematical region with a π sr spectrometer TAGX. From the missing mass spectrum of the detected proton and neutron, the ratio of final states pnd/pnpn is obtained to be 0 ± 9 %. The measured momentum spectra and angular correlations of the proton and neutron are compared with predictions of some photo-absorption mechanisms. Different from the conclusion obtained in the existing experiments, we could not find any kinematical reasoning in favor of the dominant two-nucleon absorption.

35045 (INS–729) **Σ hypernuclear bound state observed in stopped K^- reaction on ^{4}He.** Hayano, R.S.; Ishikawa, T.; Iwasaki, M.; Outa, H.; Takada, E.; Tamura, H.; Sakaguchi, A.; Aoki, M.; Yamazaki, T. Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study. Dec 1988. 12p. Order Number DE89778133/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Results are presented of inclusive measurements of $\pi^{\pm}$ momentum spectra from K^- absorption at rest in liquid helium. We found a peak in the π^- spectrum. The (K^-, π^+) spectrum does not exhibit a clear peak in the Σ^- bound region. Comparison of these two spectra suggests that the peak in the π^- spectrum is due to the formation of the S = 0, I = 1/2 ground state of Σ-nucleus bound state. (J.P.N.).

35046 (JINR-R–1-88-393) **Momentum distributions of nucleons flying out at large angles in ^{4}He-p-collisions.** Sobczak, T.; Stepaniak, J.; Glagolev, V.V. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy. 1988. 5p. (In Russian). Order Number DE89619057/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

The experiment has been performed on the 1 m HBC LHE JINR exposed in beams of ^{4}He nuclei at 8.6 GeV/c and 13.6 GeV/c momenta. Invariant differential cross sections of nucleons flying at large angles with respect to ^{4}He rest frame have been analyzed. There are some differences in the shapes of differential cross sections of the protons and neutrons between reactions with meson production and without it. These differences decrease with increasing nucleon momenta. The observed effects are connected with excited intermediate states. 16 refs.; 4 figs.

35047 (JINR-R–1-88-443) **Spectra of protons emitted at large angles in dp->pX reaction at 3.3 GeV/c.** Shimanskij, S.S.; Balgansuren, Ya.; Buzdavina, N.A. and others. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy. 1988. 3p. (In Russian). Order Number DE89619058/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Data on the inclusive inelastic differential cross sections are presented for the dp->pX reaction at 3.3 GeV/c. The ratio of the cross sections for dp->pX and dp->ppn reactions are presented. All the data are given for protons emitted in the interval cos(Θ): (-1,0,-0,66). 5 refs.; 2 figs.; 2 tabs.

35048 (JINR-R-1-88-592) **Total desintegration of helium nuclei in ^{3}Hep-interactions at 13.5 GeV/c.** Glagolev, V.V.; Lebedev, R.M.; Pestova, G.D. and others. Joint Inst. for Nuclear Research, Dubna (USSR). 1988. 7p. (In Russian). Order Number DE89619059/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

The experiment has been carried out on JINR phasotron of LHE by means of 100 cm liquid hydrogen chamber. Total cross section of the reaction of nonmesonic breakup of ^{3}He nuclei has been determined: $\sigma_{^3Hep->pppn}$=(6.73±0.15) mb. Mechanism of this reaction was analysed. It is shown that along with the mechanism of single scattering the interaction of nucleon-spectators (proton and neutron) in the final state is essential which inities their coalescence into deuteron and transition to ^{3}Hep -> dpp channel. 13 refs.; 3 figs.; 1 tab.

35049 Binding of hydrogen and helium in silicon, the mass difference between ^{3}H and ^{3}He, and the mass of ν_e. Redondo, A. (Mechanical and Electronic Engineering Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545(US)); Robertson, R. G. H. *Physical Review [Section] C: Nuclear Physics (USA),* 40(1): 368-373 (Jul 1989).

Precision measurements of the ^{3}H–^{3}He atomicmass difference afford a means for assessing the reliability of measurements ofthe electron antineutrino mass from tritium β decay. We show that along-standing discrepancy between measurements of the^{3}H–^{3}He mass difference obtained withtritium-implanted silicon detectors and those obtained by other techniques isdue to neglect of chemical binding effects in the former experiments. Thecorrection reconciles the silicon-detector results with modern determinationsmade by mass spectrometry and by β spectrometry. With this and othernew data, a revised average value for the ^{3}H–^{3}Hemass difference of 18 591(2) eV is found. The scatter in the extant datasuggests the presence of systematic errors in some of the modern measurements,and at present there seems to be no compelling basis for a model-independentlower limit on the mass of ν_e. .AE

6513 Nuclear Properties and Reactions, A=6-19, Experimental

Refer also to citation(s) 35058, 35111

35050 (IFUSP-P–730) **Fission-like decay of ^{20}Ne: eccentric behavior in the B+B fusion processes.** Toledo, A.S. de; Coimbra, M.M.; Added, N.; Anjos, R.M.; Carlin Filho, N.; Fante Junior, L.; Figueira, M.C.S.; Guimaraes, V.; Szanto, E.M. Sao Paulo Univ., SP (Brazil). Inst. de Fisica. Aug 1988. 17p. Order Number DE89619060/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Cross sections for the fusion of^{10,11}B+^{10,11}B have been measured in the energy range from 1.5 MeV/A to 5 MeV/A. The ^{10}B+^{10}B system unexpectedly presents a hindered fusion cross section when compared to the ^{10}B+^{11}B and ^{11}B+^{11}B reactions and to standard model predictions. The missing fusion cross section was diverted the ^{10}B exit channel with a total kinetic energy characteristic of strongly damped collisions. Q-values and kinematical analysis together with angular distributions suggest a binary symmetric decay of the composite ^{20}Ne system.

35051 (IFUSP-P–758) **Total reaction cross section and foward glory for ^{12}C + ^{16}O.** Villari, A.C.C.; Lepine-Szily, A.; Lichtenthaler Filho, R.; Portezan Filho, O.; Obuti, M.M. Sao Paulo Univ., SP (Brazil). Inst. de Fisica. Dec 1988. 38p. Order Number DE89619061/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A model-independent method is proposed for the determination of the total reaction cross section from elastic angular distributions. This method based on the generalized optical theorem, was applied to 16 complete elastic angular distributions of the system ^{12}C + ^{16}O at energies between E_{CM}=8.55 MeV and E_{CM} = 26.74 MeV. Some of the angular distributions were measured at the Sao Paulo Pelletron Laboratory. Angular distributions measured by the Erlangen and Saclay groups were also used. The reaction cross section is compared with fusion measurements and with σ_R obtained by indirect methods. The existence and conditions for the observation of the nuclear forward glory scattering are investigated.

35052 (KEK–88-6, pp. 41-53) **Heavy ion experiments at BNL AGS.** Akiba, Y. (Tokyo Univ. (Japan)). National Lab. for High Energy Physics, Oho, Ibaraki (Japan). Sep 1988. (CONF-8802137–: Workshop on physics of quark-gluon-plasma, Tsukuba, Japan, 18-20 Feb 1988). In *Proceedings of the workshop on physics of quark-gluon-plasma.* Order Number DE89780072/JAW. Available from NTIS (US Sales Only), PC A07/MF A01.

The report outlines major experimental results from BNL AGS heavy ion experiments. The AGS provides heavy ion beam with 14.5 GeV/c per nucleon. So far, oxygen silicon beams are accelerated. There are three major counter experiments approved at the AGS, namely E802, E810 and E814. The report addresses mainly on results from E802. First, measurements of neutral energy from O+A collisions by E806 are described. An interesting feature of the data is that edge of the observed energy distribution for O+Au and O+Cu is almost equivalent. The energy produced in the mid-rapidity is almost the same for central O+Au and for central O+Cu collisions. The transverse energy spectra for Si+Pb, Si+Cu and Si+Al are shown and discussed. The tail of the transverse energy for Si+Pb and Si+Cu reactions almost coincides. This result is consistent with the data obtained by the E802 PBGL detector for O+A collisions. The charged particle multiplicity for O+A and Si+A collisions measured by TMA detector of E802 are shown, and the multiplicity distribution is discussed. Pseudo-rapidity distributions of charged particles for central O+Au and Si-Au have also been investigated. E802 has a hadron calorimeter (ZCAL) at 0 degree of the beam line, and the detector is used to measure how much energy is left in the beam fragments. Preliminary results are outlined for Si+Al collisions. (N.K.).

35053 (KFK–4551) **Experimental investigation of direct elastic 156 MeV ^{6}Li break-up at large relative momenta of the fragments.** Heide, N. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik. Mar 1989. 125p. (In German). Order Number DE89783053/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

The triple differential cross sections $d^3\sigma/(d\Omega_\alpha d\Omega_d dE_\alpha)$ for the reactions ^{208}Pb(^{6}Li,αd)^{208}Pb and ^{12}C(^{6}Li,αd)^{12}C at 156 MeV have been measured at large asymptotic relative momenta of the fragments using position sensitive semiconductors telescopes. The measured coincidence cross-sections show beside the typical break-up bump an up to now unobserved double structure. The origin of this structure can be understood qualitatively within the spectator picture and a prior-DWBA analysis, respectively. Both of the fragments can act as a spectator with comparable propability. The coherent sum of these contributions provides the double structure in this picture. The obtainability of experimental values for the half-on-shell T-matrix for ^{6}Li scattering from the coincidence data within the diffractional dissociation model is discussed.

35054 Limiting fragmentation in oxygen-induced emulsion interactions at 14.6, 60, and 200 GeV/nucleon. Adamovich, M. I. (Academica Sinica, Beijing, People's Republic of China(CN)); Aggarwal, M. M.; Arora, R.; Alexandrov, Y. A.; Azimov, S. A.; Basova, E.; Bhalla, K. B.; Bhasin, A.; Bhatia, V. S.; Bondarenko, R. A.; and others. *Physical Review Letters (USA),* 62(24): 2801-2804 (12 Jun 1989).

Pseudorapidity distributions of relativistic singly charged particles in oxygen-induced emulsion interactions at 14.6, 60, and 200 GeV/nucleon are studied. Limiting fragmentation behavior is observed in both the target and projectile fragmentation regions for a central as well as for a minimum-bias sample. Comparisons with the fritiof model reveal that the picture of fragmenting strings successfully describes the observed data.

6514 Nuclear Properties and Reactions, A=20-38, Experimental

Refer also to citation(s) 35052, 35092

35055 (ANU-P–973) **Heavy-ion reaction studies of ^{35}P, ^{36}P.** Orr, N.A.; Catford, W.N.; Fifield, L.K.; Ophel, T.R.; Weisser, D.C.;

Woods, C.L. Australian National Univ., Canberra (Australia). Dept. of Nuclear Physics. Oct 1987. 32p. Order Number DE89619073/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The spectroscopy of the $T_z \geq 5/2$ nuclei ^{35}P and ^{36}P has been studied using a variety of multi-nucleon heavy-ion transfer reactions. This has led to the observation of a number of new levels in both nuclei. The probable structure of these and previously reported levels are deduced through comparison with DWBA and shell model calculations.

35056 (ANU-P–975) **Effects of collective excitations in the elastic scattering of vector polarized deuterons.** Nurzynski, J.; Gruebler, W.; Konig, V.; Schmelzbach, P.A. Australian National Univ., Canberra (Australia). Dept. of Nuclear Physics. Aug 1987. 11p. Order Number DE89619074/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The differential cross sections and the vector analysing powers for 12 MeV vector polarized deuterons scattered elastically from ^{40}Ar, ^{46}Ti, ^{48}Ti, ^{50}Ti, ^{52}Cr, ^{54}Cr, ^{54}Fe, ^{56}Fe, ^{58}Ni, ^{60}Ni, ^{76}Se, ^{78}Se, ^{80}Se, ^{82}Se and ^{90}Zr were analysed assuming two-channel, 0_1^+-2_1^+, coupling. In contrast with the results of conventional optical model analysis for the same isotopes, the two-channel potential parameters are found to be described well without B(E2;0^+ -2^+) dependence.

35057 (ANU-P–1006) **Measurements of Γ_γ /Γ for states of ^{24}Mg in the excitation region 10 < E_x < 12 MeV.** Vermeer, W.J.; Pringle, D.M.; Wright, I.F. Australian National Univ., Canberra (Australia). Dept. of Nuclear Physics. Apr 1988. 30p. Order Number DE89619072/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Measurements of Γ_γ /Γ have been carried out for about 40 states of ^{24}Mg in the excitation region 10 to 12 MeV using a recoil-coincidence technique. The information obtained has been combined with known values of $\omega\gamma$ to determine Γ_γ and Γ_α. Widths of the order of 0.01 to 100 eV can be determined accurately using this method. Some previous data on levels in this excitation region are discussed. Excitation energies and electromagnetic transition rates are compared with theoretical predictions. Two notable conclusions are the observation of a considerable excess in E2 strength in the 10 to 12 MeV region compared with that predicted by the shell model, and the identification of the 4^+, 11.219 MeV level as possibly being a member of a collective band based on the 0^+, 6432 MeV level.

35058 (INIS-SU–77/A, pp. 130-134) **Investigation of angular correlations in the (n,p) reaction.** Antonov, A.D. (Joint Inst. for Nuclear Research, Dubna (USSR)); Gledenov, Yu.M.; Zvarova, T.S. and others. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij. 1988. (In Russian). (CONF-870959–: 1. international conference on neutron physics, Kiev, USSR, 14-18 Sep 1987). In *Neutron physics. Vol. 1.* Order Number DE89780087/JAW. Available from NTIS (US Sales Only), PC A19/MF A01; INIS.

The results of p-even and p-odd correlations in the ^{35}Cl(n,p)^{35}S and ^{14}N(n,p)^{14}C reactions are reported. On the base of the obtained experimental data the weak interaction matrix element for ^{35}Cl is calculated. 21 refs.

35059 (IPNO-DRE–87-39) **Review of high excitation energy structures in heavy ion collisions: target excitations and three body processes.** Frascaria, N. Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire. Sep 1987. 18p. (CONF-8709200–: 1. topical meeting on giant resonance excitation in heavy-ion collisions, Legnaro, Italy, 21-25 Sep 1987). Order Number DE89781506/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

A review of experimental results on high excitation energy structures in heavy ion inelastic scattering is presented. The contribution to the spectra of the pick-up break-up mechanism is discussed in the light of the data obtained with light heavy ion projectiles. Recent results obtained with ^{40}Ar beams at various energies will show that target excitations contribute strongly to the measured cross section.

6515 Nuclear Properties and Reactions, A=39-58, Experimental

Refer also to citation(s) 35059

35060 (INIS-SU–78, pp. 248) **Gamma-ray spectrum from the ^{50}V(n,γ)^{51}V reaction at neutron energy of 2 keV.** Murzin, A.V. (AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij); Libman, V.A.; Lubchenko, N.A. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij. 1988. (In Russian). (CONF-870959–: 1. international conference on neutron physics, Kiev, USSR, 14-18 Sep 1987). In *Neutron physics. Vol. 2.* Order Number DE89012115/JAW. Available from NTIS (US Sales Only), PC A16/MF A01; INIS.

NEUTRON REACTIONS/capture; VANADIUM 50 TARGET/ neutron reactions; EXCITED STATES; GAMMA RADIATION; KEV RANGE 01-10; CAPTURE; PARITY; SPIN; VANADIUM 51

35061 (Juel-Spez–481) **Study of the small-angle correlations of charged particles from alpha-particle induced reactions on ^{58}Ni at 120 MeV.** Palarczyk, M. Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik; Bonn Univ. (Germany, F.R.). Dec 1988. 103p. (In German). Order Number DE89783052/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

Spectra of coincident light particles from the reaction ^{58}Ni(α,c_1c_2) with c_i = p,d,α at an incident energy of 120 MeV were measured for small relative angles. The smallest relative angle was $\Theta_{rel} = 2.7^0$ and the scattering angle $\Theta_{lab} = 60^0$. A dedicated detector setup was used. In the Dalitz-Plots of particle combinations as p-α, d-α and α-α resonante states are visible. The p-p final state interaction was observed. The single particle inclusive spectra for protons and deuterons show exponential slopes. This is an indication of emission from full statistical equilibrium of the composite nuclear system at low energy, and from pre-equilibrium states at higher energy. Two particle correlation functions between light ejectils, as p, d and alpha, were extracted from the experimental data. It was found that the emission of correlated protons is from the pre-compound phase and not from the (^{58}Ni+α)-compound system. The analysis of this reaction shows that the p-p correlation appears to be an incoherent, the proton-alpha correlation a coherent emission. The p-p correlation function can be described in Koonin's model of final state interactions. The analysis in the framework of this model shows that the emission of both protons occurs from a source with spatial and temporal dependences. The space extension of the emitting region was found to be r_0 = 3 fm and the parameter describing the time evolution of this region, i.e. the product of the velocity like model parameter V' and the lifetime of this region tau, was found to be V'tau = 5.5 fm.

35062 **Giant resonance strength distribution in ^{40}Ca from inelastic scattering of 500 MeV protons.** Lisantti, J. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831(US)); Horen, D. J.; Bertrand, F. E.; Auble, R. L.; Burks, B. L.; Gross, E. E.; Sayer, R. O.; McDaniels, D. K.; Jones, K. W.; McClelland, J. B.; and others. *Physical Review [Section] C: Nuclear Physics (USA)*, 40(1): 211-219 (Jul 1989). DOE Contract AC05-84OR21400.

Differential cross section measurements have been made for the giantresonance region (13.2–40 MeV) in ^{40}Ca using 500 MeVprotons with an experimental energy resolution of 70 keV. Fine structure wasobserved in this energy region. After fixing the energy weighted sum ruledepletion for the isovector giant dipole resonance at 70%, energy weighted sumrules of 70±14 % for the isoscalar giant quadrupole resonanceand 15±3 % for the isoscalar giant hexadecapole resonance werededuced. All of these energy weighted sum rule depletions agree well withtheoretical predictions and results from other experiments.

35063 **Neutron scattering and the Fermi surface anomaly in ^{51}V.** Lawson, R.D. (Argonne National Lab., IL (USA)); Guenther, P.T.; Smith, A.B. *Nuclear Physics [Section] A (Netherlands)*, 493(2): 267-292 (6 Mar 1989). DOE Contract W-31-109-ENG-38.

Differential neutron elastic- and inelastic-scattering cross sections of vanadium were measured from 4.5 to 10.0 MeV. These results

were combined with previous 1.5 to 4.0 MeV scattering data from this laboratory, the 11.1 MeV elastic-scattering results obtained at Ohio University, and the reported neutron total cross sections to energies of $\simeq$ 20 MeV, to form a data base which was interpreted in terms of the spherical optical-statistical model. A fit to the data was achieved by making both the strengths and geometries of the optical-model potential energy dependent. These energy dependencies were large below $\simeq$ 6 MeV, but were smaller, and similar to those characteristic of global models, at higher energies. Using the dispersion relationship and the method of moments, the optical-model potential deduced from the 0 to 11.1 MeV neutron scattering data was extrapolated to higher energies and to the bound-state regime. This extrapolation led to predicted neutron total cross sections that are in good agreement with experimental values to at least 20 MeV. For negative energies the values of the volume-integral per nucleon of the real potential are in excellent agreement with those needed to reproduce the observed binding energies of particle and hole states and give clear evidence of the Fermi surface anomaly. It is argued that the use of a global optical model for interpreting low-energy data is suspect but is probably a reasonable approximation at higher energies.

35064 Half-life of ^{56}Co. Lesko, K. T. (Nuclear Science Division, Lawrence Berkeley Laboratory, Berkeley, California 94720(US)); Norman, E. B.; Sur, B.; Larimer, R. *Physical Review [Section] C: Nuclear Physics (USA),* 40(1): 445-448 (Jul 1989). DOE Contract AC03-76SF00098.

The half-life of ^{56}Co was reinvestigated by measuring thetime-dependent yields of several nuclear γ-ray lines over a period of280 days. The ^{56}Co γ-ray yields were normalized tothose observed from internal standards. A value of77.08$\pm$0.08 days was deduced by averaging the resultsobtained from different γ-ray lines and source calibrations.

6516 Nuclear Properties and Reactions, A=59-89, Experimental

Refer also to citation(s) 35059, 35078

35065 (ANU-P–998) **Excitation of swift heavy ions in foil targets IV. Pre-equilibrium energy losses and mean charge states.** Bridwell, L.B.; Pender, L.F.; Sofield, C.J.; Hay, H.J.; Treacy, P.B. Australian National Univ., Canberra (Australia). Dept. of Nuclear Physics. May 1988. 23p. Order Number DE89617868/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Studies have been made of the approach to energy-loss and charge-state equilibrium of initially pure charge states of ions, transmitted through thin carbon targets. Ions of Li, F and Cl at 3 MeV per AMU were used. Detailed observations were made of outgoing energy losses and charge-state distributions, for outgoing charges equal to those ingoing. A Monte Carlo analysis is made of the charge-changing processes, which allows calculation of energy losses due to projectile charge exchange. The residual electronic target-ionisation loss is analysed to predict in-target charge states of the projectile ions. Using these, a comparison is made between the in-target effective charge for target ionisation, and the averaged ionic charge which fits charge-exchange data.

35066 (CRN-PN–8614) **Search for superdeformation in ^{144}Gd.** Vivien, J.P.; Nourreddine, A.; Beck, F.A.; Byrski, T.; Gehringer, C.; Haas, B.; Merdinger, J.C.; Dudek, J.; Radford, D.C.; Schutz, Y. Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires. 1986. 43p. Order Number DE89781503/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Quasi-continuum γ-decay studies of ^{144} Gd have been performed using the ^{120}Sn(^{28}Si,4n)reaction at 125, 135, 145 and 155 MeV bombarding energies. Angular distribution and multiplicity measurements have been done at the above energies. At 145 MeV bombarding energy a lifetime measurement has also been performed. Although a collective behaviour has been observed, the present data do not give evidence for population of superdeformed rotational bands. Theoretical interpretation using the cranking model with the Woods-Saxon field is given. The effects of temperature and pairing on the superdeformed configuration are discussed; superdeformation effects are predicted to disappear below I $\sim$ 60-70 Planck constant when temperature exceeds $\sim$ 500 KeV.

35067 (IFUSP-P–748) **Angular correlation measurement in ^{80}Kr.** Pascholati, P.R.; Oliveira, R.A.A.M. de; Goldman, I.D. Sao Paulo Univ., SP (Brazil). Inst. de Fisica. Nov 1988. 11p. Order Number DE89619079/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A multipole mixing ratio of 3.9(9) of the 2^+_2 - 2^+_1 616 KeV transition in ^{80}Kr was determined by gamma-gamma angular correlation using a Ge(Li)-NaI(T1) spectrometer. Previous measurements of this mixing ratio with results 6(1), -0.5, 3(3) and $16^{\infty}{}_{-8}$ are not in mutual agreement. Available conversion electron coefficient data can not explain the δ-value.

35068 (INIS-SU–78, pp. 224) **Measurement of resonance integrals of ^{70}Ge and ^{74}Ge activation.** Beda, A.G. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij. 1988. (In Russian). (CONF-870959–: 1. international conference on neutron physics, Kiev, USSR, 14-18 Sep 1987). In *Neutron physics. Vol. 2.* Order Number DE89012115/JAW. Available from NTIS (US Sales Only), PC A16/MF A01; INIS.

GERMANIUM 70 TARGET/neutron reactions; GERMANIUM 74 TARGET/neutron reactions; NEUTRON REACTIONS/resonance integrals; EXPERIMENTAL DATA

6517 Nuclear Properties and Reactions, A=90-149, Experimental

Refer also to citation(s) 34356, 35092

35069 (INDC(GER)–033/GX) **Double differential cross-sections for the (p,n) reactions of 13.1 MeV protons with Mo-94,95,96,97,98,100.** Broer, T.; Mordhorst, E.; Stamer, S.; Trabandt, M.; Scobel, W. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Apr 1989. 13p. Order Number DE89617870/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Cross sections for the inclusive production of neutrons of 13.13$\pm$0.15 MeV protons with all stable Molybdenum isotopes (with the exception of ^{92}Mo) have been measured with time-of-flight techniques for 22 angles ranging from 3 deg. to 177 deg. (author) 9 refs, 3 figs, 2 tabs.

35070 (INIS-SU–78, pp. 189) **Determination of averaged resonance parameters of holmium in the neutron energy range of (2+-0.4) keV.** Vertebnyj, V.P. (AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij); Gnidak, N.L.; Novoselov, G.M.; Pavlenko, E.A.; Senchenko, T.A.; Lyubanskij, G.B. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij. 1988. (In Russian). (CONF-870959–: 1. international conference on neutron physics, Kiev, USSR, 14-18 Sep 1987). In *Neutron physics. Vol. 2.* Order Number DE89012115/JAW. Available from NTIS (US Sales Only), PC A16/MF A01; INIS.

HOLMIUM ISOTOPES/excited states; HOLMIUM ISOTOPES/ neutron reactions; ENERGY-LEVEL DENSITY; KEV RANGE 01-10; LEVEL WIDTHS; SCATTERING LENGTHS; SELF-SHIELDING; STRENGTH FUNCTIONS; TOTAL CROSS SECTIONS

35071 (INIS-SU–78, pp. 229-231) **Parameters of neutron resonances of ^{142}Ce and ^{143}Pr ($T_{1/2}$=13.6 d) nuclides.** Anufriev, V.A. (Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Dimitrovgrad (USSR)); Babich, S.I.; Nikol'skij, S.N. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij. 1988. (In Russian). (CONF-870959–: 1. international conference on neutron physics, Kiev, USSR, 14-18 Sep 1987). In *Neutron physics. Vol. 2.* Order Number

DE89012115/JAW. Available from NTIS (US Sales Only), PC A16/MF A01; INIS.

The measurements of the total neutron cross section for ^{142}Ce and ^{143}Pr($T_{1/2}$=13,6 d) were performed at the SM-2 reactor. Resonance parameters for ^{142}Ce six levels and for ^{143}Pr five levels were calculated over the energy up to 10000 eV. 6 refs.; 2 tabs.

35072 (IPNO-DRE–88-06) **Inelastic heavy ion scattering on ^{90}Zr and ^{208}Pb at intermediate energies.** Blumenfeld, Y.; Beaumel, D.; Chomaz, P.; Frascaria, N.; Garron, J.P.; Jacmart, J.C.; Roynette, J.C.; Scarpaci, J.A.; Suomijarvi, T.; Barrette, J. Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire. 1988. 17p. (CONF-880195–: 26. international winter meeting on nuclear physics, Bormio, Italy, 25-29 Jan 1988). Order Number DE89781594/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Heavy ion inelastic scattering has been investigated using the SPEG spectrometer at GANIL. It is shown that the use of such a high resolution spectrometer allows a quantitative study of the giant resonances excited in heavy ion collisions. The contribution of the pick-up break-up mechanism to the high excitation energy region (E > 30 MeV) is then discussed. Recent results obtained with ^{40}Ar beams at two different incident energies show that target excitations are also present in this energy region.

35073 (IPNO-DRE–88-07) **Intermediate-mass fragments: a probe for the mechanisms involved in H.I. collisions around E/A = 30 MeV.** Borderie, B.; Jouan, D.; Rivet, M.F.; Cabot, C.; Gardes, D.; Gauvin, H.; Jacquet, D.; Monnet, F.; Montoya, M.; Hanappe, F. Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire. Feb 1988. 13p. (CONF-880195–: 26. international winter meeting on nuclear physics, Bormio, Italy, 25-29 Jan 1988). Order Number DE89781598/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Intermediate-mass fragments emitted in coincidence with heavy residues in the reaction 27 MeV/nucleon Ar + Ag have been measured. A continuous evolution of the mechanisms producing these fragments is observed, from incompletely damped deeply inelastic collisions when the intermediate-mass fragment is emitted forward, up to 30^0, to completely dissipative collisions, when the fragment is found past 50^0. Information about preequilibrium emission is also derived in connection with the degree of dissipation of the collisions. Finally, semi-classical calculations (Landau-Vlasov) which reproduce experimental observations well, sustain the proposed mechanisms.

35074 (JINR-R–1-88-520) **Neutral star characteristics in (π^--Xe)-interactions at 3.5 GeV/c.** Grishin, V.G.; Miller, K.; Pluta, J.; Tas, P.; Strugalski, Z. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy. 1988. 6p. (In Russian). Order Number DE89619083/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

The preliminary results on the neutron characteristics investigated from (π^--Xe) interactions at 3.5 GeV/c momentum are presented. The number of neutral stars on one collision is 0.65, the ratio of the forward-backward neutron emission is F/B=2.1. Multiplicity distribution of neutral stars and the distribution on charge track number in neutral stars are given. The cross sections of neutron interaction with xenon nuclei and the weights of neutral star registration in dependence on neutron momenta in the region up to 1.0 GeV/c are estimated. 8 refs.; 3 figs.; 2 tabs.

35075 (JINR-R–6-88-562) **^{147}Eu decay scheme and ^{147}Sm excited state structure.** Adam, J.; Dobes, J.; Zakoucky, D.; Kracik, B.; Navratil, P.; Zhelev, Zh.T.; Penev, I.; Mikhajlova, M. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems. 1988. 14p. (In Russian). Order Number DE89619084/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Submitted to the journal Izv. Akad. Nauk SSSR, Ser. Fiz.

Using the experimental data on the differential-integral γ-coincidences the decay scheme of ^{147}Eu has been constructed in which the levels 716,6; 1106,8; 1172,6; 1219,7; 1317,8; 1349,6; 1600,9; 1641,9 keV have been established for the first time in β-decay. The excitation by β-decay of the levels: 872,9; 1006,7; 1228,1; 1303,7; 1588,2; 1629,9 and 1658,4 keV have not been confirmed. Additionally for the states of ^{147}Sm the spins, parities and the log ft of correspondent values have been determined. The correspondence between the experimental and calculated energies of the ^{147}Sm - levels has been obtained in the framework of interactiong boson-fermion model. On the basis of the description of transition probabilities and log ft-values a conclusion about the necessity of taking into account in the operator of the transition an exchange terms has been drawn. 25 refs.; 2 figs.; 4 tabs.

35076 (JINR-R–6-88-563) **Gamma-rays at the ^{147}Eu -> ^{147}Sm decay.** Adam, J.; Zakoucky, D.; Kracik, B.; Zhelev, Zh.T.; Penev, I. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems. 1988. 14p. (In Russian). Order Number DE89619085/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Submitted to Izv. Akad. Nauk SSSR, Ser. Fiz.

Using a suppressed-compton spectrometer in investigation of γ-rays from the decay of ^{147}Eu is performed. More than 24 new γ-transitions have been identified in the decay of ^{147}Eu and about 30 γ-transitions have been shown not to belong to this decay. New information is obtained about the placement of γ-rays into the decay scheme of ^{147}Eu on the basis of the integral-differential γ-coincidence measurements. 29 refs.; 4 tabs.

35077 (Juel-Spez–482) **Structure studies on the nuclides ^{96}Zr and ^{98}Zr via the high-spin β^--decays of the Y fission products.** Stolzenwald, M.L. Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik; Koeln Univ. (Germany, F.R.). Dec 1988. 86p. (In German). Order Number DE89783051/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

In the framework of this thesis the β^--decay of the high-spin states of the ^{96}Y and ^{98}Y parent nuclei of ^{96}Zr and ^{98}Zr was studied. These isomeric states were populated in the fission of the ^{235}U by means of thermal reactor neutrons. The term schemes of ^{96}Zr and ^{98}Zr could be essentially extended. By the evaluation of the angular correlations in ^{96}Zr for ten levels precise spin assignments could be made and for seven states the possible spin values confined to few alternatives. The study of the β^--feeding resulted that mainly the 4390 keV level in ^{96}Zr is populated by the β^--decay with a logft value of 5.0. The angular-correlation analysis gives a spin I = 8 for the 4390 keV level. With this experimental results and theoretical calculations with the IBFFM model on spin and parity $I^-\pi = 8^+$ of the ^{96}Y high-spin isomer with a $[\pi g_9 2/\chi \mu g_7 2/]$ configuration could be concluded. Furthermore the mixing parameters δ for two mixed M1/E2 transitions were determined which suggest with the values δ_{289} = -0.5(4) for the (6_2^+ -> 6_1^+) and δ_{475} = 0.1(2) for the (4_2^+ -> 4_1^+) transitions predominating M1 multipolarities. In ^{98}Zr only the angular correlation of the cascade of the four most intensive transitions 1223, 620, 647, and 1801 keV was studied whereby also here the spins of each level could be determined. It resulted that both an I = 6 state at an energy of E = 4292 keV and an I = 4 level at E = 2491 keV in ^{98}Zr is strongly populated by the β^--decay. Therefore it is assumed that spin and parity o the β^--decaying high-spin isomer of ^{98}Y $I^\pi = 5^+$ are which shall be confirmed by theoretical calculations with the IBFFM model. (orig./HSI).

35078 (LUIP–8805) **Calender of high multiplicity ^{16}O induced reactions in Ag(Br) at 200A MeV.** Schussler, F.; Monnand, E.; Nifenecker, H.; Jakobsson, B.; Joensson, G.; Karlsson, L.; Kopljar, V.; Noren, B.; Soederstroem, K. Lund Univ. (Sweden). Dept. of Cosmic and Subatomic Physics. May 1988. 109p. (LUNFD6-NFFK–7088-1-107-1988). Order Number DE89617871/JAW. Available from NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS.

This calendar contains information about all charged particles in 50 high multiplicity ^{16}O + ^{107}Ag or ^{80}Br events in nuclear emulsions between 200A MeV and 220A MeV. A stack of 26 Ilford G5 pellicles, each 10*10*0.06 cm^3, has been exposed horizontally to the 250A MeV ^{16}O beam from the Berkeley Bevalac with a flux of $5*10^4$ ions/cm^2. All charged particles with a range >= 5 μm are registered and indentified by conventional methods. Except for Z=1 particles, no mass determination could be performed experimentally and the adopted mass values are otherwise those of the most stable isotopes. The tables could be used to: Estimation of source velocity. Correlation studies of various kind - angles, phase space etc. Flow tensor calculations. (author) (50 tables, 50 figures).

35079 Production of helium (Z=2) projectile fragments in ^{16}O-emulsion interactions from *E/A*=2 to 200 GeV. Adamovich, M. I. (Lebedev Physical Institute, 117924, Moscow, U.S.S.R.(SU)). *Physical Review [Section] C: Nuclear Physics (USA),* 40(1): 66-72 (Jul 1989).

The fragmentation of relativistic ^{16}O projectiles in nuclear emulsion into projectile fragments of $Z \geq 2$ has been investigated. Production rates, charge, and multiplicity distribution of such projectile fragments and their dependence on target-fragment multiplicities have been obtained. The width of the momentum distribution of He (Z=2) projectile fragments as well as the average number of target fragments is found to decrease with increasing He multiplicity. These dependences are, within errors of measurement, the same for *E/A*=2.1, 14.6, 60, and 200 GeV, and to that extent satisfy the condition of limiting fragmentation.

35080 *g* factor of the (59/2$^-$ isomer in ^{147}Gd. Hass, M. (Argonne National Laboratory, Argonne, Illinois 60439(US)); Ahmad, I.; Janssens, R. V. F.; Khoo, T. L.; Korner, H. J.; Moore, E. F.; Wolfs, F. H. L.; Benczer-Koller, N.; Dafni, E.; Beard, K.; and others. *Physical Review [Section] C: Nuclear Physics (USA),* 39(6): 2237-2241 (Jun 1989). DOE Contract W-31-109-ENG-38.

The *g* factor of the 10 995 keV,J^π=59/2$^-$, and $T_{1/2}$=0.8 ns level in ^{147}Gd has beendetermined by the transient field method for ions recoiling through amagnetized Gd foil at a temperature of 100 K. The^{76}Ge(^{76}Ge,5*n*)^{147}Gd reactionat *E*(^{76}Ge)=310 MeV was used to provide high recoil velocity. A 100 ps flight time in vacuum between the target and the ferromagnet of 100 ps ensured that the γ-ray cascades fed the 59/2 level before the recoil ions traversed the Gd foil. The *g* factor was extracted from standard double ratios with the known parametrization of the transient field, yielding *g*=0.38(7). This value is in agreement with the predicted wave function and experimental single-particle moments in this mass region. Results for levels in ^{145,148}Gd were also obtained.

6518 Nuclear Properties and Reactions, A=150-189, Experimental

Refer also to citation(s) 33555, 35070, 35094

35081 (ANU-P–1004) **Shape co-existence in ^{180}Hg and delineation of the midshell minimum.** Dracoulis, G.D.; Stuchbery, A.E.; Macchiavelli, A.O.; Beausang, C.W.; Burde, J.; Deleplanque, M.A.; Diamond, R.M.; Stephens, F.S. Australian National Univ., Canberra (Australia). Dept. of Nuclear Physics. May 1988. 13p. Order Number DE89619094/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Excited states in ^{180}Hg have been identified. Yrast states up to spin 16$^+$ are assigned. The decay pattern observed is indicative of a shape co-existence similar to that in the heavier Hg isotopes. The prolate deformed band is higher in energy, relative to the oblate band, than in ^{182}Hg, establishing a clear minimum in the prolate-oblate energy difference near N = 103, midshell for the $i_{13}2/$ neutrons.

35082 (INIS-mf–11456, pp. 443-446) **Reduced probabilities of γ transitions in erbium isotopes (A=158-170) and isotones with N=94 (A=158-164).** Adam, J. (Ceskoslovenska Akademie Ved, Rez (Czechoslovakia). Ustav Jaderne Fyziky); Honusek, M.; Wagner, V. Jednota Ceskoslovenskych Matematiku a Fyziku, Prague (Czechoslovakia). 1987. (In Czech). (CONF-8707217–: 9. conference of Czechoslovak physicists, Pardubice, Czechoslovakia, 6-10 Jul 1987). In *Ninth conference of Czechoslovak physicists. Part 1, 2.* Order Number DE89617602/JAW. Available from NTIS (US Sales Only), PC A22/MF A01 - OSTI; INIS.

Available experimental data on deformed erbium isotopes (Z=68) and isotones with N=94 are used to verify the assumptions used for deriving formulas for reduced probabilities of E2 gamma transitions of the deexciting level of rotational bands of beta or gamma vibrational states to the levels of rotational bands of ground state g. The calculated values are given of parameters Z for the beta and gamma bands. Good agreement is shown with experimental data. (Z.J.). 2 figs., 2 tabs., 24 refs.

35083 (INIS-SU–78, pp. 201-203) **Cross section of thermal neutron capture by ^{152m}Eu isomer (9.3 hours).** Kondurov, I.A. (AN SSSR, Leningrad (USSR). Inst. Yadernoj Fiziki); Korotkikh, E.M.; Shulyak, G.I. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij. 1988. (In Russian). (CONF-870959–: 1. international conference on neutron physics, Kiev, USSR, 14-18 Sep 1987). In *Neutron physics. Vol. 2.* Order Number DE89012115/JAW. Available from NTIS (US Sales Only), PC A16/MF A01; INIS.

The capture cross section of ^{152m}Eu for thermal neutrons σ_γ=(18.4±4.0)x10^3 b is measured. The experimental value of neutron and radiation widths ratio Γ_n/Γ_γ=(1.5±0.5)x10^{-5} is obtained using the result of the previous paper of the same authors. 6 refs.

35084 (INIS-SU–78, pp. 220-224) **Neutron resonances of radioactive isotope gadolinium-153 ($T_{1/2}$=241.6 days).** Vertebnyj, V.P. (AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij); Vorona, P.N.; Kal'chenko, A.I.; Krivenko, V.G.; Chervyakov, V.Yu.; Chervonnaya, L.E. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij. 1988. (In Russian). (CONF-870959–: 1. international conference on neutron physics, Kiev, USSR, 14-18 Sep 1987). In *Neutron physics. Vol. 2.* Order Number DE89012115/JAW. Available from NTIS (US Sales Only), PC A16/MF A01; INIS.

Neutron resonance parameters for radioctive isotope Gd-153 are reporeted in the energy range of 0-60 eV. Average level spacing is found to be D=(3.0±0.6) eV. Corrected value for thermal neutron cross section as σ_t=23.000±2.000 g. 2 refs.; 2 figs.; 2 tabs.

35085 (IPNO-DRE–88-10) **Charge radius changes in even-a platinum nuclei.** Le Blanc, F.; Kilcher, P.; Obert, J.; Oms, J.; Putaux, J.C.; Roussiere, B.; Sauvage, J.; Savard, G.; Lee, J.K.P.; Crawford, J.E. Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire. 1988. 16p. Order Number DE89781601/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Isotope shift measurements on even-A Pt isotopes have been obtained from A=186 to A=198. Charge radii differences have been extracted and are compared to constrained Hartree-Fock + BCS calculations. A possible shape transition between ^{186}Pt and ^{188}Pt is discussed.

35086 Coupling between the β and γ vibration in tungsten nuclei. Wu, C. Y. (Nuclear Structure Research Laboratory, University of Rochester, Rochester, New York 14627(US)); Cline, D.; Vogt, E. G.; Kernan, W. J.; Czosnyka, T.; Kavka, A.; Diamond, R. M. *Physical Review [Section] C: Nuclear Physics (USA),* 40(1): 3-6 (Jul 1989). DOE Contract AC03-76SF00098.

The quadrupole collectivity in $^{182-184}$W has beenstudied by means of heavy-ion coulomb excitation with ^{58}Ni and^{136}Xe projectiles; the deexcitation γ rays weremeasured in γ-*p*-*p* triple coincidence experiments. Thesedata were used to determine, model-independently, both the static andtransition matrix elements for the low-lying states in these nuclei with asemiclassical Coulomb-excitation least-squares search code. The results for thequadrupole moments of the second 2$^+$ states and the *E*2transitions between the γ band and the ground-state band in thesenuclei do not support the prediction of a strong mixing between the β-and γ-vibrational bands in tungsten nuclei made by thepairing-plus-quadrupole model of Kumar and Baranger.

35087 Shape coexistence in ^{187}Au. Johansson, J. K. (Tandem Accelerator Laboratory, McMaster University, Hamilton, Canada L8S 4K1(CA)); Popescu, D. G.; Rajnauth, D. D.; Waddington, J. C.; Carpenter, M. P.; Courtney, L. H.; Janzen, V. P.; Larabee, A. J.; Liu, Z. M.; Riedinger, L. L.; and oth *Physical Review [Section] C: Nuclear Physics (USA),* 40(1): 132-144 (Jul 1989).

The level structure of odd-proton ^{187}Au was studied using the ^{172}Yb(^{19}F,4*n*) reaction. Gamma-gamma coincidence, angular distributions and γ-γ-time measurements were used to establish the energies, spins, parities, and lifetimes for the states in the decay scheme of ^{187}Au. Both prolate and oblate structures have been established. The prolate bands are built on the $\pi h_{9/2}$ α=±(1/2) and the $\pi i_{13/2}$ (α=1/2) particle states. Anoblate, strongly coupled band

built on a 90±10 ns isomericstate is reported for the first time. A second oblate structure built on the $h_{11/2}$ proton-hole state was established to much higher spinthan before. The backbend present in the $\pi i_{13/2}$ band hasbeen interpreted as the alignment of a pair of $h_{9/2}$ protons.

6519 Nuclear Properties and Reactions, A=190-219, Experimental

Refer also to citation(s) 35052, 35053, 35072, 35085, 35320

35088 (ANU-P–987) **Low lying yrast structure of ^{212}Po.** Poletti, A.R.; Dracoulis, G.D.; Byrne, A.P.; Stuchbery, A.E. Australian National Univ., Canberra (Australia). Dept. of Nuclear Physics. Jul 1987. 19p. Order Number DE89619101/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The properties of states in ^{212}Po populated by the ^{206}Pb(^{9}Be,αn) ^{212}Po reaction have been investigated. the previously proposed yrast scheme below 3MeV has been verified and eight further transitions placed in the level scheme. Mean lives of the 6^+, 8^+ and (10^+) states at 1355, 1476 and 1834 keV have been measured as 1.1(3), 24.6(3) and 0.8(2)ns respectively. Shell model calculations using effective interactions were used to interpret the observed scheme. A synthesis of all available theoretical and experimental evidence allows the 65s isomer to be identified clearly as the 18^+ level arising primarily from the $\pi(h_9 2/^2)^* \nu(g_9 2/i_{11} 2/)$ configuration.

35089 (BNL–42804) **Results for strange particle production from BNL experiment E802.** Abbott, T.; Akiba, Y.; Alburger, D.; Beavis, D.; Betts, R.R.; Birstein, L.; Bloomer, M.A.; Bond, P.D.; Chasman, C.; Chu, Y.Y. The E802 Collaboration. Brookhaven National Lab., Upton, NY (USA). 1988. 12p. Sponsored by DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-8810264–13: Conference on hadronic matter in collision, Tucson, Arizona, USA, 6-12 Oct 1988). Order Number DE89014189/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Results are presented for inclusive measurements of π, K, proton and deuteron spectra from 14.5 A·GeV/c Si central collisions with Au targets. Pseudo-rapidity distributions of charged particles from a variety of targets are also shown. Ratios of K to π yields are large and increase with $p_\perp$ for Si + Au collisions. 4 refs., 11 figs.

35090 (CONF-8901120–3) **Transverse energy and neutral pion spectra obtained from ^{16}O- and ^{32}S-induced reactions at 200 GeV/nucleon.** Plasil, F.; Albrecht, R.; Awes, T.C.; Baktash, C.; Beckmann, P.; Berger, F.; Bock, R.; Claesson, G.; Clewing, G.; Dragon, L. WA80 Collaboration. Oak Ridge National Lab., TN (USA). 1989. 9p. Sponsored by DOE Energy Research. DOE Contract AC05-84OR21400. From 27. international winter meeting on nuclear physics; Bormio, Italy; 23-27 Jan 1989. Order Number DE89013058/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The main goal of the CERN heavy-ion experiments is the search for an indication that the predicted state of deconfined quarks and gluons, the quark-gluon plasma (QGP), has been produced. The most promising indication that this may, in fact, be the case comes from the NA38 dimuon measurements, which are focused on the question of J/ψ suppression. This effect was predicted to be one of the signatures of QGP formation before any measurements were made, and it is the subject of the two other talks at this conference that deal with nucleus-nucleus reactions at ultrarelativistic energies. In this presentation we consider the general (global) features of heavy-ion reactions at CERN energies, and we examine the degree to which they differ from mere superpositions of nucleon-nucleon collisions. We discuss the present status of our data analysis and our main conclusions from the first round of CERN experiments with emphasis on transverse energy measurements, on attained energy densities, and on the spectra of produced neutral pions. Because of time limitations we will not discuss our measurements of distributions of charged particles and the analysis of these distributions in terms of fluctuations nor the results that we have obtained with the Plastic Ball on the behavior of target spectator matter. 20 refs., 5 figs.

35091 (GANIL-P–88-11) **Hot nuclei and search for multifragmentation in medium-energy heavy-ion collisions.** Doubre, H. Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France). 1988. 13p. (CONF-880766–: 5. international conference on clustering aspects in nuclear and subnuclear systems, Kyoto, Japan, 25-29 Jul 1988). Order Number DE89781590/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Some recent determinations of the excitation energies and temperatures of composite systems formed in intermediate-energy heavy-ion collisions are described and the issue of a limiting temperature is discussed. Several examples of experimental investigations of an eventual occurrence of a multifragmentation process are also described.

35092 (INS–731) **Formation of deeply bound π^- states from hypernuclear decay.** Bando, H.; Yamazaki, T.; Zofka, J. Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study. Jan 1989. 17p. Order Number DE89778134/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The formation probabilities of deeply bound states of π^- from hypernuclear weak decay are calculated. The best candidate for detecting narrow 1s and 2p π^- bound states is ^{208}Pb, where the signature, a sharp peak in a proton spectrum, attains a strength, which may be within the future experimental reach.

35093 (JINR-R–1-88-703) **Interaction of relativistic protons and ^{12}C nuclei with lead target.** Voronko, V.A.; Kostin, V.Ya.; Migalenya, V.Ya. and others. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy. 1988. 4p. (In Russian). Order Number DE89619103/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

The measurement of intensity of the neutron flux generated in a lead target of 50x50x80 cm^3 in size with the proton and ^{12}C nuclear beams with 9 GeV/c and 4.5 GeV/c momentum per nucleon, respectively, was carried out. Ratio of neutron intencity per one nucleus of ^{12}C to the intensity per one proton was 7.2±1.4 at 27 cm distance from the face target and 14.0±2.9 at 78 cm distance. It is shown that the contribution of neutrons of energy more than 10 MeV into the total spectrum of generated in a lead target neutrons is essentially higher than that in the fission neutron spectrum. 6 refs.; 2 figs.

35094 (LBL–27177) **Non-equilibrium fission processes in intermediate energy nuclear collisions.** Loveland, W.; Casey, C.; Xu, Z.; Seaborg, G.T.; Aleklett, K.; Sihver, L. Lawrence Berkeley Lab., CA (USA). Apr 1989. 8p. Sponsored by DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-890406–22: Fifty years with nuclear fission conference, Gaithersburg, Maryland, USA, 25-28 Apr 1989). Order Number DE89013695/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We have measured the target fragment yields, angular and energy distributions for the interaction of 12-16 MeV/A^{32}S with ^{165}Ho and ^{197}Au and for the interaction of 32 and 44 MeV/A ^{40}Ar with ^{197}Au. The Au fission fragments associated with the peripheral collision peak in the folding angle distribution originate in a normal, "slow" fission process in which statistical equilibrium has been established. At the two lowest projectile energies, the Au fission fragments associated with the central collision peak in the folding angle distribution originate in part from "fast" ($\tau \sim 10^{-23}$s), non-equilibrium processes. Most of the Ho fission fragments originate in non- equilibrium processes. The fast, non-equilibrium process giving rise to these fragments has many of the characteristics of "fast fission", but the cross sections associated with these fragments are larger than one would expect from current theories of "fast fission. " 14 refs., 8 figs.

35095 **Different continuum approaches to giant resonances in ^{208}Pb with 400-MeV protons.** Swenson, L. W. (Oregon State University, Corvallis, Oregon 97330(US)); Chen, X. Y.; Lisantti, J.; McDaniels, D. K.; Bergqvist, I.; Bertrand, F. E.; Horen, D. J.; Gross, E. E.; Glover, C.; Sayer, R. O.; and others. *Physical Review [Section] C: Nuclear Physics (USA),* 40(1): 246-255 (Jul 1989). DOE Contract AC05-84OR21400.

New ^{208}Pb(p,p') measurements at 400 MeV arereported and analyzed using new approaches to the continuum in the giantresonance region. These approaches include a phenomenological procedure, andcalculations based on the free surface response function of semi-infinitenuclear matter. These methods are found to lead to giant resonance parameterswhich are consistent and in agreement

with established results. We interpretthis to mean that both approaches provide empirically consistentrepresentations of the continuum underlying the giant resonances. In additionto the well-known resonances, evidence of possible $3\hbar\omega$ L=5resonance strength is observed at 18-MeV excitation accounting for10±3 % of the energy-weighted sum rule.

6520 Nuclear Properties and Reactions, A=220 and Above, Experimental

Refer also to citation(s) 35091, 35125, 35126

35096 (INDC(CCP)–292/L, pp. 15-18) **Average kinetic energy of fission fragments.** Vorob'eva, V.G.; Kuz'minov, B.D. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Jan 1989. In *Translation of selected papers published in Nuclear Constants 2, 1985.* Order Number DE89613030/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Original report in Russian was distributed as INDC(CCP)-248/G.

The experimental data on the mean kinetic energy of fission fragments for a fixed nucleonic structure and excitation energy of fissionable nuclei are analysed and the numerical data have been reduced to a single standard. 8 tabs.

35097 (INDC(CCP)–292/L, pp. 19-25) **Dependence of the fission cross-sections for heavy nuclei on neutron energy in the "plateau" region.** Smirenkin, G.N.; Fursov, B.I. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Jan 1989. In *Translation of selected papers published in Nuclear Constants 2, 1985.* Order Number DE89613030/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Original report in Russian was distributed as INDC(CCP)-248/G.

The paper presents a wide set of experimental data on fission probability and fast neutron cross-sections for Pa-Cf nuclei in the first "plateau" region (E_n = 1-7 MeV). Energy dependences of the fission cross-sections, fission probabilities and compound nucleus formation cross-sections are compared. Some conformity to natural laws governing the fission probability energy dependence as function of nucleon composition of fissionable nuclei is identified. 4 figs, 1 tab.

35098 (INDC(CCP)–293/L, pp. 19-32) **Prompt neutron spectra from fission of ^{233}U, ^{235}U and ^{239}Pu by thermal neutrons and from spontaneous fission of ^{252}Cf in the 0.01-12 MeV energy range.** Starostov, B.I.; Nefedov, V.N.; Bojtsov, A.A. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Jan 1989. In *Translation of selected papers published in Nuclear Constants 3, 1985.* Order Number DE89613037/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

Original report in Russian was distributed as INDC(CCP)-252/G.

The prompt neutron spectra from the thermal fission of ^{233}U, ^{235}U, ^{239}Pu and from the spontaneous fission of ^{252}Cf in the energy range 0.01-12 MeV have been measured using the same spectrometer over the whole energy range in two cycles differing in the methods used to detect neutrons and fission fragments. 4 figs, 5 tabs.

35099 (INIS-SU–78, pp. 179-183) **Inelastic neutron scattering and p-neutron strength function of thorium 232 and uranium 238.** Litvinskij, L.L. (AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij); Vertebnyj, V.P.; Libman, V.A.; Murzin, A.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij. 1988. (In Russian). (CONF-870959–: 1. international conference on neutron physics, Kiev, USSR, 14-18 Sep 1987). In *Neutron physics. Vol. 2.* Order Number DE89012115/JAW. Available from NTIS (US Sales Only), PC A16/MF A01; INIS.

Thorium 232 and uranium 238 neutron-inelastic scattering cross sections at 144 keV neutron energy and p-wave strength functions have been determined. 12 refs.; 3 figs.

35100 (INIS-SU–78, pp. 190-194) **Measurement of resonance parameters of ^{232}Th and their integral check through the resonance integral.** Kobayashi, K. (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.); Fujita, Y.; Kimura, I. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij. 1988. (CONF-870959–: 1. international conference on neutron physics, Kiev, USSR, 14-18 Sep 1987). In *Neutron physics. Vol. 2.* Order Number DE89012115/JAW. Available from NTIS (US Sales Only), PC A16/MF A01; INIS.

In order to make an integral check of the resonance parameters, the resonance integral for the ^{232}Th(n,γ) reaction has been calculated with the parameters measured here and with the evaluated parameters in JENDL-2, ENDF/B-IV and -V, and these calculated results have been compared with the measurement made in a standard 1/E spectrum field. The calculation has also been performed by exchanging the parameters in the evaluated libraries for those presently measured. Resonance parameters in JENDL-2 have been found to be smaller than those measured, especially for the first four s-wave resonances. 15 refs.; 4 tabs.

35101 (INIS-SU–78, pp. 195-200) **Measurement of self-shielding factors of neutron capture cross sections for ^{232}Th and ^{238}U in the unresolved resonance region.** Fujita, Y. (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.); Kobayashi, K.; Oigawa, H. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij. 1988. (CONF-870959–: 1. international conference on neutron physics, Kiev, USSR, 14-18 Sep 1987). In *Neutron physics. Vol. 2.* Order Number DE89012115/JAW. Available from NTIS (US Sales Only), PC A16/MF A01; INIS.

Self-shielding factors of neutron capture cross sections for Th-232 and U-238 have been measured in the resonance energy region from 1 to 35 keV, using the linac time-of-flight method at the Research Reactor Institute, Kyoto University. The self-shielding factor for an arbitrary dilution cross section has been obtained from a set of measured neutron transmission spectra and self-indication ratio measurements for several transmission samples of different thickness. The measured self-shielding factors have been compared with calculations performed using average resonance parameters from the evaluated nuclear data files JENDL-2 and ENDF/B-IV. The calculated shielding factors for Th-232 are in good agreement with the measurements within an experimental error of about 5%. For U-238, when the recent average parameters obtained by Olsen are employed, agreement between measurement and calculation is within 2-3%. This value is better than those calculated using JENDL-2 and EDF/B-IV data. 6 refs.; 6 figs.; 1 tab.

35102 (INIS-SU–78, pp. 203) **Measurement of radiative neutron capture cross section of uranium 238.** Varlamov, V.E. (AN SSSR, Leningrad (USSR). Inst. Yadernoj Fiziki); Laptev, A.B.; Shcherbakov, O.A. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij. 1988. (In Russian). (CONF-870959–: 1. international conference on neutron physics, Kiev, USSR, 14-18 Sep 1987). In *Neutron physics. Vol. 2.* Order Number DE89012115/JAW. Available from NTIS (US Sales Only), PC A16/MF A01; INIS.

NEUTRON REACTIONS/capture; URANIUM 238 TARGET/ neutron reactions; CROSS SECTIONS; EV RANGE; GAMMA RADIATION; KEV RANGE 01-10; KEV RANGE 10-100; CAPTURE

35103 (INIS-SU–78, pp. 279-282) **Comparative analysis of evaluated ^{239}Pu cross sections in resolved resonance region.** Luk'yanov, A.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Atomnoj Ehnergii); Kolesov, V.V.; Sinitsa, V.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij. 1988. (In Russian). (CONF-870959–: 1. international conference on neutron physics, Kiev, USSR, 14-18 Sep 1987). In *Neutron physics. Vol. 2.* Order Number DE89012115/JAW. Available from NTIS (US Sales Only), PC A16/MF A01; INIS.

The average cross sections and self-shielding factors were calculated using multilevel analysis remeters up to 500 eV. The results were compared with other evaluations. 6 refs.; 2 tabs.

35104 (INIS-SU–78, pp. 283-287) **Neutron cross sections of uranium 236 for thermal and resonance neutrons.** Vorona, P.N. (AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij); Vertebnyj, V.P.; Kal'chenko, A.I.; Krivenko, V.G.; Chervonnaya, L.E.; Chervyakov, V.Yu. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij. 1988. (In Russian). (CONF-870959–: 1. international conference on neutron physics, Kiev, USSR, 14-18 Sep 1987). In *Neutron physics. Vol. 2.* Order Number DE89012115/JAW. Available from NTIS (US Sales Only), PC A16/MF A01; INIS.

Neutron time-of-flight spectrometer was used for uranium samples transmission measurements (U-metal and U_3O_8, enrichment-99.845% ^{236}U). Neutron energy dependence of σ_t for thermal neutrons and neutron resonance parameters up to 100 eV were received. σ_t (0.0253 eV)=16.0±0.1 barn. 4 refs.; 2 figs.; 3 tabs.

35105 (INIS-SU–78, pp. 303-308) **Measurement of multiplicity and total energy of gamma radiation from the ^{235}U fission by resonance neutrons.** Gundorin, N.A. (Joint Inst. for Nuclear Research, Dubna (USSR)); Duka-Zojomi, A.; Kliman, Ya.; Krishtiak, J. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij. 1988. (In Russian). (CONF-870959–: 1. international conference on neutron physics, Kiev, USSR, 14-18 Sep 1987). In *Neutron physics. Vol. 2.* Order Number DE89012115/JAW. Available from NTIS (US Sales Only), PC A16/MF A01; INIS.

The multiplicity and the total energy of the gamma-rays from ^{235}U neutron resonances fission were measured. Weak difference between mean gamma-ray energies for the $J^{\pi}=3^-$ and 4^- compound states is reported, $\Delta\epsilon=(16\pm10)$ keV. 8 refs.; 4 figs.; 2 tabs.

35106 (INIS-SU–78, pp. 309-312) **Radiative capture cross sections of thermal neutrons for ^{236}U and ^{232}Th.** Davletshin, A.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (USSR). Fiziko-Ehnergeticheskij Inst.); Sinitsa, V.V.; Tipunkov, A.O.; Tikhonov, S.V.; Tolstikov, V.A. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij. 1988. (In Russian). (CONF-870959–: 1. international conference on neutron physics, Kiev, USSR, 14-18 Sep 1987). In *Neutron physics. Vol. 2.* Order Number DE89012115/JAW. Available from NTIS (US Sales Only), PC A16/MF A01; INIS.

^{236}U and ^{232}Th thermal capture cross sections have been measured relative to ^{197}Au thermal capture cross section by the activation technique. The results have been compared with the reported data. 9 refs.; 1 tab.

35107 (INIS-SU–78, pp. 316) **Average resonance parameters of ^{238}U.** Van'kov, A.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (USSR). Fiziko-Ehnergeticheskij Inst.); Ukraintsev, V.F.; Gosteva, L.S. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij. 1988. (In Russian). (CONF-870959–: 1. international conference on neutron physics, Kiev, USSR, 14-18 Sep 1987). In *Neutron physics. Vol. 2.* Order Number DE89012115/JAW. Available from NTIS (US Sales Only), PC A16/MF A01; INIS.

URANIUM 238 TARGET/neutron reactions; CAPTURE; CROSS SECTIONS; GAMMA RADIATION; KEV RANGE; SELF-SHIELDING; TRANSMISSION

35108 (INIS-SU–78, pp. 331-333) **Summary results of measurements of 10-300 keV neutron transmission for thorium.** Filippov, V.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (USSR). Fiziko-Ehnergeticheskij Inst.). Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij. 1988. (In Russian). (CONF-870959–: 1. international conference on neutron physics, Kiev, USSR, 14-18 Sep 1987). In *Neutron physics. Vol. 2.* Order Number DE89012115/JAW. Available from NTIS (US Sales Only), PC A16/MF A01; INIS.

The values of total cross section measured with samples of different thickness for neutron having energies above 10 keV are collected. The average cross section and self-shielding factor values are presented. 5 refs.; 1 tab.

35109 (JAERI-M–88-252) **Measured data of delayed gamma-ray spectra from fissions of ^{232}Th, ^{233}U, ^{235}U, ^{238}U and ^{239}Pu by fast neutrons, tabular data.** Akiyama, Masatsugu; Katakura, Jun-ichi. Japan Atomic Energy Research Inst., Tokyo (Japan). Dec 1988. 242p. Order Number DE89778111/JAW. Available from NTIS (US Sales Only), PC A11/MF A01.

Measured gamma-ray spectrum data are presented in tabular form for fissions of ^{232}Th, ^{233}U, ^{235}U, ^{238}U and ^{239}Pu by fast neutrons. The spectral data are useful for validating the reliability of nuclear data used for summation calculation. The measurements were performed at YAYOI reactor of the University of Tokyo. The data were obtained by a NaI(T1) detector. The raw data were unfolded to provide spectral distributions. The distributions are presented in tabular form for energy range from 100 keV to 5 MeV. The data are represented in a unit of photons/fission/sec/MeV.

35110 **Neutron scattering cross sections up to 2.4 MeV for the ground and first two excited states of ^{232}Th.** Goswami, G.C. (Univ. of Lowell, Dept. of Physics and Applied Physics, Lowell, MA (US)); Egan, J.J.; Kegel, G.H.R.; Mittler, A.; Sheldon, E. *Nuclear Science and Engineering (USA)*, 100(1): 48-60 (Sep 1988).

Differential cross sections have been measured at the University of Lowell for the ground and first two excited states of ^{232}Th via the neutron time-of-flight technique. The following results are presented for neutron scattering cross sections: (a) excitation functions of ^{232}Th in the incident energy range from 185 to 2400 keV for the 0^+ ground state and the 2^+, 49-keV state, and in the 480- to 2400-keV range for the 4^+, 162-keV state; (b) angular distributions for the 0^+ and 2^+ states at 185 kev and for the 0^+, 2^+, and 4^+ states at 550 keV. Level cross sections were obtained using these and previously measured angular distributions.

6530 Nuclear Theory

Refer also to citation(s) 34973, 35039, 35075, 35097, 35322, 35325, 35328, 35336, 35339, 35340, 35341, 35350

35111 (ANU-P–991) **Energy dependence of the ^{16}O - ^{208}Pb effective interaction.** Lim, C.S.; Rebgetz, M.D.; Spear, R.H.; Vermeer, W.J.; Fewell, M.P.; Robson, B.A.; Smith, R. Australian National Univ., Canberra (Australia). Dept. of Nuclear Physics. Nov 1987. 10p. Order Number DE89619004/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

The Coulomb-nuclear interference in the excitation probability of the 2.615 MeV (3^-) state of ^{208}Pb by ^{16}O at θ_{CM} 172 deg for bombarding energies between 57 MeV and 79 MeV has been studied. The data are described by an effective interaction which has a behaviour similar to that expected from the dispersion relation connecting the real and imaginary parts of the generalized optical potential.

35112 (CEA-CONF–9323) **Nucleon structure and the chiral filter.** Rho, M. CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Theorique. 1987. 10p. (CONF-870909–: Conference on nuclear interactions and structures, Brighton, UK, 7-9 Sep 1987). Order Number DE89781505/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

I discuss the issues of quenched g_A in nuclei, pionic enhancement of nuclear electromagnetic form factors, manifestation of the anomalous Wess-Zumino term in nuclear medium, all on the same footing, in terms of the nucleon structure as 'derived' from a low-energy effective theory of QCD.

35113 (CRN-PN–88-31) **Comparison of the ^{13}C + ^{16}O reaction with ^{12}C + ^{17}O.** Freeman, R.M.; Haas, F.; Morsad, A.; Beck, C. Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires. 1988. 19p. Order Number DE89781550/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The $^{13}C + ^{16}0$ reaction has been studied by the kinematic coincidence technique in the $E_{c.m.}$ range between 19 and 30 MeV. Angular distributions and excitations functions were compared with results from $^{12}C + ^{17}0$ over the same energy range. Notable differences were found between the elastic angular distributions for the two reactions. Optical model fits were performed to determine which parameters were sensitive to these differences. Broad structures, like shape resonances, were most apparent in the $^{13}C + ^{16}0$ reaction, particularly for the excitation of collective states. Transfer reactions involving single-particle states, show a more complex energy dependence.

35114 (IC–88/422) **Modified VMD model with correct analytic properties for describing electromagnetic structure of He^4 nucleus.** Dubnicka, S.; Lucan, L. International Centre for Theoretical Physics, Trieste (Italy). Dec 1988. 17p. Order Number DE89618974/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A new phenomenological model for electromagnetic (e.m.) form factor (ff) of He^4 nucleus is presented, which is based on a modification of the well proved in e.m. interactions of hadrons vector-meson-dominance (VMD) model by means of an incorporation of correct He^4 ff analytic properties, nonzero vector-meson widths and the right power asymptotic behaviour predicted by the quark model. It reproduces the existing experimental information on He^4 e.m. ff in the space-like region quite well. Furthermore, couplings of all well established isoscalar vector mesons with $J^{pc} = 1^{--}$ to He^4 nucleus are evaluated as a result of the analysis and the time-like region behaviour of He^4 e.m. ff is predicted. As a consequence of the latter the total cross section of e^+e^- -> He^4He-bar^4 process is calculated for the first time. (author). 17 refs, 3 figs.

35115 (IC–89/8) **Parity nonconserving asymmetries in the resonance scattering and nuclear reactions induced by polarized protons.** Dumitrescu, O.; Horoi, M.; Carstoiu, F.; Stratan, G. International Centre for Theoretical Physics, Trieste (Italy). Jan 1989. 21p. Order Number DE89619005/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The parity-nonconserving nucleon-nucleon (PNC-NN) interaction studied in nuclear systems provides an unique window on $\Delta S=0$ hadronic weak processes. To check the predictions concerning the interactions between weak hadronic currents, low energy nuclear physics processes appear to be very suitable. Considering the nuclear reactions induced by polarized protons as low energy nuclear processes we derive expressions for the longitudinal and irregular transverse PNC analysing powers, when the reactions take place via parity mixed resonances. Applications for $^{13}C(p\text{-vector},p)^{13}C$, $^{15}N(p\text{-vector},p)^{15}N$ and $^{15}N(p\text{-vector},\alpha)^{12}C$ resonance reactions are done. (author). 23 refs, 4 figs, 2 tabs.

35116 (IC–89/14) **Four-nucleon correlations and the origin of the odd-even staggering of nuclear charge RADII of isotopes of one element.** Dumitrescu, O.; Horoi, M.; Bulboaca, I. International Centre for Theoretical Physics, Trieste (Italy). Jan 1989. 10p. Order Number DE89618975/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

In the enlarged superfluid model (ESM), recently proposed, by including an adequate four-nucleon interaction in addition to the pairing effective residual interaction, global correlations between proton and neutron fluids other than two-nucleon pairing and long-range correlations in atomic nuclei are induced. Among the new effects that the ESM can explain, good results can be obtained for the odd-even staggering of the charge radii of isotopes of one element. (author). 32 refs, 1 fig., 2 tabs.

35117 (IC–89/27) **Superfluid isomers in Samarium region.** Dumitrescu, O.; Horoi, M. International Centre for Theoretical Physics, Trieste (Italy). Jan 1989. 10p. Order Number DE89618977/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

A superfluid isomer by analogy with the fission (shape) isomers is theoretically predicted and found among the 0^+ excited states of ^{152}Sm. (author). 10 refs, 3 figs, 1 tab.

35118 (IFUSP-P–727) **Sp(1,R) calculation in a deformed harmonic oscillator basis.** Avancini, S.S.; Passos, E.J.V. de. Sao Paulo Univ., SP (Brazil). Inst. de Fisica. Aug 1988. 28p. Order Number DE89618978/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A qualitative analysis of the results of an Sp(1,R) calculation for ^8Be, in a deformed harmonic oscillator basis is performed. The model basis of states is given by the angular momentum projection of deformed phonon states, determined by the method of variation after projection. These deformed phonons are associated to giant monopole and quadrupole resonances.

35119 (IFUSP-P–744) **Solution to the Fokker-Planck equation for proton-nucleus collisions at high energies.** Pato, M.P.; Nemes, M.C. Sao Paulo Univ., SP (Brazil). Inst. de Fisica. Nov 1988. 9p. Order Number DE89619006/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

The analytical solutions to a kinetic description of proton-nucleus collisions are presented. Friction and diffusion coefficients include Pauli blocking effects. The results are compared with the solutions obtained from Glauber's theory.

35120 (IFUSP-P–751) **Evaluation of E2 form factor = ^{24}Mg.** Marinelli, J.R.; Moreira, J.R. Sao Paulo Univ., SP (Brazil). Inst. de Fisica. Nov 1988. 20p. Order Number DE89619008/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Longitudinal and transverse electron scattering form factors for the 2^+ state at 1.37 Mev of the ^{24}Mg nucleus was evaluated with rotational model wavefunctions. Four different approaches were used for the transverse E2 form factor: PHF, cranking model, ridig rotor and irrotational flow. For the nuclear intrinsic wavefunction, the Nilsson model was assumed in all approaches yielding the calculation of the form factor in PWBA and DWBA. The results are discussed and compared with a recent measurement performed with 180^0 electron scattered from this state. The DWBA calculation, taking into account first order corrections shows that PHF and irrotational flow models give the best agreements with the available data and compete in quality with more complex calculation performed under the 'shell model' approach.

35121 (IFUSP-P–753) **Field theoretical approach to proton-nucleus reactions: I - one step inelastic scattering.** Eiras, A.; Kodama, T.; Nemes, M.C. Sao Paulo Univ., SP (Brazil). Inst. de Fisica. Nov 1988. 32p. Order Number DE89619009/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A closed form expression to the double differential cross section for one step proton-nucleus reaction within a field theoretical framework is obtained. Energy and momentum conservation as well as nuclear structure effects are consistently taken into account within the field theoretical eikonal approximation. In this formulation the Kinematics of such reaction is not dominated by the free nucleon-nucleon cross section but a new factor which called relativistic differential cross section in a Born Approximation.

35122 (IFUSP-P–754) **Importance of the Dirac sea on the dynamical behaviour of scalar meson masses.** Providencia, J. da; Nemes, M.C.; Goncalves, E.; Oliveira, M.M. de; Fiolhais, C. Sao Paulo Univ., SP (Brazil). Inst. de Fisica. Nov 1988. 28p. Order Number DE89618979/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The importance of the Dirac sea is discussed in the context of two models: the Relativistic Scalar Plasma and the well known σ-ω model. As far as the ground state is concerned, the Dirac sea is shown to play a decisive role to guarantee its stability. Furthermore, renormalization effects on the spectra of scalar particles are shown to change the spectra drastically. A comparison between the models allows for a deeper understanding of the role played by the vector mesons in nuclear matter.

35123 (IFUSP-P–759) **Faddeev and DWBA description of inclusive break-up and incomplete fusion reactions.** Hussein, M.S.; Frederico, T.; Mastroleo, R.C. Sao Paulo Univ., SP (Brazil). Inst. de Fisica. Dec 1988. 32p. Order Number DE89619010/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Three-Body Contributions to the inclusive break-up cross section are derived and discussed. The Faddeev equations are used for the purpose. A new sum rule, similar in structure to the Ichimura,

Austern and Vicent sum rule, but contains the full three-body corrections at the DWBA level, is derived and analysed within a Glauber-type approximation. Application of our theory to the extraction of astrophysically interesting information on charged particle induced reactions at low relative are made.

35124 (INDC(CCP)–297/GE) **International Evaluated Nuclear Structure Data File (ENSDF) in fundamental and applied photonuclear research.** Boboshin, I.N.; Varlamov, V.V. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Apr 1989. 11p. Order Number DE89618980/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Translation of a selected paper from Nuclear Constants 3, 1985, original in Russian was distributed as INDC(CCP)-252/G.

In order to provide the necessary nuclear physics data from the ENSDF file to those carrying out fundamental or applied photonuclear research a specialized software system was set up on an ES computer. A brief description of the block diagram of this software package and of one of the programs in this package (SUPER) is given. 4 refs, 6 figs.

35125 (INDC(CCP)–298/L) **Translation of selected papers published in Nuclear Constants 2, 1988.** International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Apr 1989. 70p. Order Number DE89619041/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

Translated by the IAEA. Original report in Russian was distributed as INDC(CCP)-294/G.

The document includes the English translation of 6 papers published in Nuclear Constants 2, 1988. A separate abstract was prepared for each of these papers. Refs, figs and tabs.

35126 (INDC(GDR)–50/L) **Influence of atomic, molecular and solid state effects on the neutron resonance cross-section.** Seidel, K.; Seeliger, D.; Meister, A.; Mittag, S.; Pilz, W. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Mar 1989. 51p. Order Number DE89617851/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

This paper gives a review of recent research into the influence of atomic, molecular and solid-state effects in a target on the cross-section for the interaction of neutrons with nuclei at low-energy neutron resonances. The influence of these effects on Doppler broadening is examined, and calculated and experimental results are compared. The results are also given of an investigation of temperature and chemical shifts in neutron resonances analogous to the second-order Doppler effect and isomer shift familiar from Moessbauer gamma-ray spectroscopy. (author). 56 refs, 17 figs, 3 tabs.

35127 (INIS-mf–11396) **32nd Annual conference and the 22nd annual theoretical seminar of the South African Institute of Physics.** South African Inst. of Physics, Faure (South Africa). 1987. 108p. (In English, Afrikaans). (CONF-8707216–: 32. Annual conference of the South African Institute of Physics, Durban, South Africa, 13-17 Jul 1987). Order Number DE89615754/JAW. Available from NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS.

This publication contains only the abstracts of seminars.

The 32nd annual conference and the 22nd annual theoretical seminar of the South African Institute of Physics was held from 13-17 July 1987 at the University of Natal, Durban. This publication contains only the abstracts of seminars delivered on the conference. The topics that were covered include the various facets of physics such as solid state physics, nuclear and particle physics, optics and spectroscopy, solar-terrestrial physics, education, and applied and industial physics.

35128 (INIS-mf–11456, pp. 423-426) **Theoretical investigation of nuclei in reactions with pions and kaons.** Mach, R. (Ceskoslovenska Akademie Ved, Rez (Czechoslovakia). Ustav Jaderne Fyziky); Majling, L. Jednota Ceskoslovenskych Matematiku a Fyziku, Prague (Czechoslovakia). 1987. (In Czech). (CONF-8707217–: 9. conference of Czechoslovak physicists, Pardubice, Czechoslovakia, 6-10 Jul 1987). In *Ninth conference of Czechoslovak physicists. Part 1, 2.* Order Number DE89617602/JAW. Available from NTIS (US Sales Only), PC A22/MF A01 - OSTI; INIS.

In connection with the prepared start-up of the meson factory at the Institute of Nuclear Research in Moscow the authors contemplate the possible results of the study of nuclei in reactions with pions and kaons and the best orientation of the research. Attention is focused on subnuclear mechanisms of nuclear forces, on the reaction of pions with light nuclei and on the structure and decay of hypernuclei. (Z.J.). 3 figs., 14 refs.

35129 (INIS-mf–11456, pp. 435-438) **Relativistic meson-nucleon theory of nuclei.** Antalik, R. (Slovenska Akademia Vied, Bratislava (Czechoslovakia). Fyzikalny Ustav); Gmuca, S. Jednota Ceskoslovenskych Matematiku a Fyziku, Prague (Czechoslovakia). 1987. (In Slovak). (CONF-8707217–: 9. conference of Czechoslovak physicists, Pardubice, Czechoslovakia, 6-10 Jul 1987). In *Ninth conference of Czechoslovak physicists. Part 1, 2.* Order Number DE89617602/JAW. Available from NTIS (US Sales Only), PC A22/MF A01 - OSTI; INIS.

The present state is discussed of relativistic theories describing nuclear matter. Main attention is concentrated on quantum hadrodynamics. Equations of motion are given for the scalar meson field, for the mass vector field and for the nucleon field. Attention is also paid to the relativistic optical model and its description of scattering problems. (Z.J.). 11 refs.

35130 (INIS-mf–11456, pp. 439-442) **Proton resonances at energies up to 3 MeV.** Sterba, F. (Karlova Univ., Prague (Czechoslovakia). Fakulta Matematicko-Fyzikalni). Jednota Ceskoslovenskych Matematiku a Fyziku, Prague (Czechoslovakia). 1987. (In Czech). (CONF-8707217–: 9. conference of Czechoslovak physicists, Pardubice, Czechoslovakia, 6-10 Jul 1987). In *Ninth conference of Czechoslovak physicists. Part 1, 2.* Order Number DE89617602/JAW. Available from NTIS (US Sales Only), PC A22/MF A01 - OSTI; INIS.

Some current aspects are discussed of the study of nuclear reactions with protons at proton energies of up to 3 MeV. Main attention is paid to proton resonances. Some applications are given using resonance reactions with protons. (Z.J.). 2 figs., 17 refs.

35131 (INIS-SU–77/A, pp. 372-376) **Application of theoretical models for prediction of neutron cross sections of poorly investigated nuclei with using ^{238}Pu as an example.** Klepatskij, A.B. (AN Belorusskoj SSR, Minsk (Byelorussian SSR). Inst. Yadernoj Ehnergetiki); Maslov, V.M.; Porodzinskij, Yu.V.; Sukhovitskij, E.Sh. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij. 1988. (In Russian). (CONF-870959–: 1. international conference on neutron physics, Kiev, USSR, 14-18 Sep 1987). In *Neutron physics. Vol. 1.* Order Number DE89780087/JAW. Available from NTIS (US Sales Only), PC A19/MF A01; INIS.

Nuclear models are of importance to neutron data prediction for poorly investigated nuclei. The models are employed for ^{238}Pu neutron data evaluation. The regions of resolved resonances (10^{-5}-500eV), unresolved resonances (0.5-150keV) and energy range of fast neutrons (0.15-20MeV) are considered. 10 refs.; 2 figs.

35132 (INIS-SU–78, pp. 53-57) **Statistical description of neutrino scattering in presence of direct processes.** Ezhov, S.N. (Kievskij Gosudarstvennyj Univ., Kiev (Ukrainian SSR)); Kabakova, N.E.; Plyujko, V.A. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij. 1988. (In Russian). (CONF-870959–: 1. international conference on neutron physics, Kiev, USSR, 14-18 Sep 1987). In *Neutron physics. Vol. 2.* Order Number DE89012115/JAW. Available from NTIS (US Sales Only), PC A16/MF A01; INIS.

The improved computation method of a fluctuation component of an everage cross section of neutron scattering both with and without allowance for inelastic transitions is formulated. 23 refs.; 3 figs.

35133 (INIS-SU–78, pp. 150-154) **On the structure of total width of neutron S resonances.** Rudak, Eh.A. (AN Belorusskoj SSR, Minsk (Byelorussian SSR). Inst. Fiziki). Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij. 1988. (In Russian).

(CONF-870959–: 1. international conference on neutron physics, Kiev, USSR, 14-18 Sep 1987). In *Neutron physics. Vol. 2.* Order Number DE89012115/JAW. Available from NTIS (US Sales Only), PC A16/MF A01; INIS.

In terms of the Fock-Krylov theorem an analytical expression has been obtained for the total width of neutron resonance s-tates. It is shown that in general case the total width is not a simple sum of the elastic and the inelastic widths.

35134 (INIS-SU–78, pp. 102-106) **New results on theoretical analysis of (n, α) reaction on light and medium nuclei.** Bychkov, V.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (USSR). Fiziko-Ehnergeticheskij Inst.); Zelenetskij, A.V.; Pashchenko, A.B. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij. 1988. (In Russian). (CONF-870959–: 1. international conference on neutron physics, Kiev, USSR, 14-18 Sep 1987). In *Neutron physics. Vol. 2.* Order Number DE89012115/JAW. Available from NTIS (US Sales Only), PC A16/MF A01; INIS.

In the framework of modern theoretical models of nuclear reactions an analysis has been done of the excitation functional and emission spectra of the neutron threshold reactions at neutron energies up to 20 MeV. The results of the analysis indicate the considerable difference between the alpha-particle transmission coefficients for the excited and ground state nucleus. 11 refs.; 4 figs.

35135 (INIS-SU–78, pp. 116-119) **Method of averaging over resonance cross sections within R matrix theory.** Vysotskij, A.G. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Atomnoj Ehnergii); Luk'yanov, A.A.; Savova, N.; Yaneva, N. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij. 1988. (In Russian). (CONF-870959–: 1. international conference on neutron physics, Kiev, USSR, 14-18 Sep 1987). In *Neutron physics. Vol. 2.* Order Number DE89012115/JAW. Available from NTIS (US Sales Only), PC A16/MF A01; INIS.

The analytic method of resonance cross-section averaging with account of level width fluctuations and interference effects is presented. 5 refs.; 1 fig.

35136 (INIS-SU–78, pp. 120-124) **Equations for averaged scattering amplitude in the random matrix method.** Girko, V.L. (Kievskij Gosudarstvennyj Univ., Kiev (Ukrainian SSR)); Ezhov, S.N.; Plyujko, V.A. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij. 1988. (In Russian). (CONF-870959–: 1. international conference on neutron physics, Kiev, USSR, 14-18 Sep 1987). In *Neutron physics. Vol. 2.* Order Number DE89012115/JAW. Available from NTIS (US Sales Only), PC A16/MF A01; INIS.

The integral equations describing the dependence of averaged S-matrix on distribution of the resonance parameters are obtained. These equations have a simple structure in the case when numbers of levels and statistically independent channels are larger. 16 refs.

35137 (INIS-SU–78, pp. 125-129) **Effects of strong coupling between compound states and scattering channel of low-energy neutrons.** Danilin, B.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Atomnoj Ehnergii). Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij. 1988. (In Russian). (CONF-870959–: 1. international conference on neutron physics, Kiev, USSR, 14-18 Sep 1987). In *Neutron physics. Vol. 2.* Order Number DE89012115/JAW. Available from NTIS (US Sales Only), PC A16/MF A01; INIS.

The results of the interpolation approach have stimulated the development of the model of strong coupling between the compound states. Assuming the surface transition to the CS, an analytical expression for the S matrix was found. 3 refs.; 3 figs.

35138 (INIS-SU–78, pp. 130-134) **Theory of correlation phenomena in nuclear reactions in the region of overlapping resonance levels.** Kun, S.Yu. (AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij). Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij. 1988. (In Russian). (CONF-870959–: 1. international conference on neutron physics, Kiev, USSR, 14-18 Sep 1987). In *Neutron physics. Vol. 2.* Order Number DE89012115/JAW. Available from NTIS (US Sales Only), PC A16/MF A01; INIS.

The correlation dependences between polarization observables as well as them like ones values and nuclear reaction cross sections are studied. The general regularity of the transition from the pure statistical reaction region at the cross section minima to the direct interactions one at the cross section maxima is found. The physical reason for statistical correlations is discussed. 6 refs.

35139 (INIS-SU–78, pp. 135-138) **Role of structure effects of nucleus in fast neutron scattering on chromium 52 nucleus.** Kashuba, I.E. (AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Teoreticheskoj Fiziki); Porodzinskij, Yu.V.; Sukhovitskij, E.Sh. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij. 1988. (In Russian). (CONF-870959–: 1. international conference on neutron physics, Kiev, USSR, 14-18 Sep 1987). In *Neutron physics. Vol. 2.* Order Number DE89012115/JAW. Available from NTIS (US Sales Only), PC A16/MF A01; INIS.

A coupled channel formalism for describing elastic and inelastic scattering from soft ^{52}Cr nucleus with β- and γ-collective motion is considered. The results calculated according to the model developed with the determined parameter values taking into account the contribution of processes passing through the compound nucleus stage describe a large array of data on neutron interaction with chromium-52 nuclei up to 15 MeV energy that testifies to the effectiveness of the model proposed. The present calculated results are compared with the experimental data. 8 refs.; 4 figs.

35140 (INIS-SU–78, pp. 139-143) **Optical potential of neutron interaction with lead nuclei in the energy range of 0.00025-16 MeV.** Anikin, G.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (USSR). Fiziko-Ehnergeticheskij Inst.); Kotukhov, I.I. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij. 1988. (In Russian). (CONF-870959–: 1. international conference on neutron physics, Kiev, USSR, 14-18 Sep 1987). In *Neutron physics. Vol. 2.* Order Number DE89012115/JAW. Available from NTIS (US Sales Only), PC A16/MF A01; INIS.

The energy dependence of parameters have been investigated for the optical potential with "common geometry". The more complex form-factors being used than for the Woods-Saxon potential. 5 refs.; 4 figs,; 1 tab.

35141 (INIS-SU–78, pp. 144-149) **On the contribution of direct processes to cross section of charge-exchange ^{58}Ni(n,p)^{58}Co reaction.** Borzov, I.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (USSR). Fiziko-Ehnergeticheskij Inst.); Pronyaev, V.G.; Trykov, E.L. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij. 1988. (In Russian). (CONF-870959–: 1. international conference on neutron physics, Kiev, USSR, 14-18 Sep 1987). In *Neutron physics. Vol. 2.* Order Number DE89012115/JAW. Available from NTIS (US Sales Only), PC A16/MF A01; INIS.

The coupled channel method with microscopic charge-exchange transition potentials have been used to calculate ^{58}Ni(n,p)^{58}Co reaction cross sections for 0.1 -> 6.5 and 18.5 MeV neutrons with $J^{\pi}=1^{+}$ -> 6^{+} isobaric state excitation. The direct reaction mechanism is shown to give noticeable contribution to the high energy part of the proton spectra. 11 refs.; 3 figs.

35142 (INIS-SU–78, pp. 155-159) **Multiphonon variant of coupled channel method and neutron strength functions.** Samojlov, V.V. (Moskovskij Inzhenerno-Fizicheskij Inst., Moscow (USSR)); Urin, M.G. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh

Issledovanij. 1988. (In Russian). (CONF-870959–: 1. international conference on neutron physics, Kiev, USSR, 14-18 Sep 1987). In *Neutron physics. Vol. 2.* Order Number DE89012115/JAW. Available from NTIS (US Sales Only), PC A16/MF A01; INIS.

Within the many-phonon coupled-channel method A-dependences of S- and p-neutron strength functions (NSF) are calculated. It is shown that for a number of nuclei it is necessary to take into account many-phonon states and that such nuclei the NSF value is weakly dependent of the optical potential imaginary part intensity. 13 refs.; 4 figs.

35143 (INIS-SU–78, pp. 167) **Radiative capture of valence neutron within the model of strong coupling of compound states with scattering channel.** Danilin, B.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Atomnoj Ehnergii). Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij. 1988. (In Russian). (CONF-870959–: 1. international conference on neutron physics, Kiev, USSR, 14-18 Sep 1987). In *Neutron physics. Vol. 2.* Order Number DE89012115/JAW. Available from NTIS (US Sales Only), PC A16/MF A01; INIS.

NEUTRON REACTIONS/capture; NEUTRON REACTIONS/elastic scattering; COMPOUND NUCLEI; CROSS SECTIONS; ENERGY LEVELS; ENERGY-LEVEL TRANSITIONS; LEVEL WIDTHS; CAPTURE; QUANTUM OPERATORS

35144 (INIS-SU–78, pp. 167) **Strength function of neutrons and effective optical potential within the model of strong coupling of compound states and scattering channel.** Danilin, B.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Atomnoj Ehnergii). Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij. 1988. (In Russian). (CONF-870959–: 1. international conference on neutron physics, Kiev, USSR, 14-18 Sep 1987). In *Neutron physics. Vol. 2.* Order Number DE89012115/JAW. Available from NTIS (US Sales Only), PC A16/MF A01; INIS.

NEUTRON REACTIONS/nuclear potential; NEUTRON REACTIONS/strength functions; COMPOUND NUCLEI; ENERGY LEVELS; OPTICAL MODELS

35145 (INIS-SU–78, pp. 168) **Neutron-nucleus reaction as a quasiclassical multistep process.** Abdullaev, Kh.Sh. (AN SSSR, Moscow (USSR). Inst. Yadernykh Issledovanij); Kazarnovskij, M.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij. 1988. (In Russian). (CONF-870959–: 1. international conference on neutron physics, Kiev, USSR, 14-18 Sep 1987). In *Neutron physics. Vol. 2.* Order Number DE89012115/JAW. Available from NTIS (US Sales Only), PC A16/MF A01; INIS.

NEUTRON REACTIONS; ELASTIC SCATTERING; INELASTIC SCATTERING; SEMICLASSICAL APPROXIMATION

35146 (INIS-SU–78, pp. 265) **Simulation of probability values of total neutron cross section by gamma distribution.** Filippov, V.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (USSR). Fiziko-Ehnergeticheskij Inst.); Tarasko, M.Z. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij. 1988. (In Russian). (CONF-870959–: 1. international conference on neutron physics, Kiev, USSR, 14-18 Sep 1987). In *Neutron physics. Vol. 2.* Order Number DE89012115/JAW. Available from NTIS (US Sales Only), PC A16/MF A01; INIS.

NEUTRON REACTIONS/simulation; NEUTRON REACTIONS/total cross sections; DISTRIBUTION FUNCTIONS; KEV RANGE 100-1000; MEV RANGE 01-10; SIMULATION

35147 (INIS-SU–78, pp. 313-316) **Semiempirical determination of average cross sections for radiative neutron capture.** Nedvedyuk, K. (Lodz Univ. (Poland). Inst. Fizyki); Lason', L.; Popov, Yu.P. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij. 1988. (In Russian). (CONF-870959–: 1. international conference on neutron physics, Kiev, USSR, 14-18 Sep 1987). In *Neutron physics. Vol. 2.* Order Number DE89012115/JAW. Available from NTIS (US Sales Only), PC A16/MF A01; INIS.

On the basis of recently published experimental $<\sigma\ (n,\gamma)>$ values at E_n=30 keV and relationships considered previously new estimations of the average cross sections, for isotopes, for which experimental data are not available are obtained. Evaluated cross sections for 52 isotopes of 16 elements are presented from Se to Pb. 9 refs.; 2 figs.

35148 (INIS-SU–78, pp. 343-347) **Calculated methods of estimation of multiple neutron interaction effects in samples with allowance for resonance structure of cross sections.** Androsenko, A.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (USSR). Fiziko-Ehnergeticheskij Inst.); Androsenko, P.A.; Van'kov, A.A.; Kazakov, L.E. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij. 1988. (In Russian). (CONF-870959–: 1. international conference on neutron physics, Kiev, USSR, 14-18 Sep 1987). In *Neutron physics. Vol. 2.* Order Number DE89012115/JAW. Available from NTIS (US Sales Only), PC A16/MF A01; INIS.

Results of analytical and Monte Carlo calculations of corrections for neutron self-shielding and multiple collisions in samples and neutron detector materials for radiative capture cross section measurements are given. The results are compared with ones of approximate calculational method. 15 refs.; 2 figs.

35149 (IPNO-DRE–87-36) **Deeply inelastic collisions as a source of intermediate mass fragments at E/A = 27 MeV*.** Borderie, B.; Montoya, M.; Rivet, M.F.; Jouan, D.; Cabot, C.; Fuchs, H.; Gardes, D.; Gauvin, H.; Jacquet, D.; Monnet, F. Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire. 1987. 13p. Order Number DE89781510/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Intermediate-mass fragments detected in coincidence with heavy residues were measured in ^{40}Ar induced reactions on Ag at E/A = 27 MeV. From the observed characteristics, it is inferred that intermediate-mass fragments associated with the so-called intermediate-velocity source come essentially from deeply inelastic collisions.

35150 (IPNO-DRE–87-41) **Search for characteristics of preequilibrium protons emitted in Ar + Ag collisions at E/A = 27 MeV.** Jouan, D.; Rivet, M.F.; Borderie, B.; Gauvin, H.; Cabot, C.; Fuchs, H.; Gardes, D.; Jacquet, D.; Monnet, F.; Montoya, M. Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire. Dec 1987. 13p. Order Number DE89781511/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Protons emitted in coincidence with heavy residues have been measured, for the reaction 27 MeV per nucleon ^{40}Ar + ^{nat}Ag. From the proton velocity spectra, an anisotropic component was extracted, which shows a broad angular distribution, and a mean velocity larger than the beam velocity. Multiplicities for this component are low, about 0.8, independent of the violence of the collision. For central collisions, selected via the higher heavy residue velocities, the velocity characteristics of the anisotropic component, seen in this case as a pure preequilibrium component, were compared to semi-classical calculations (Landau-Vlasov).

35151 (IPNO-DRE–88-18) **Inelastic scattering of 400 MeV polarized deuterons on ^{12}C, ^{24}Mg and ^{40}Ca.** Morlet, M.; Djalali, C.; Van de Wiele, J.; Willis, A.; Mandon, T.; Bonin, B. Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire. 1988. 11p. Order Number DE89781531/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

the δS=1, δT=0 transitions were studied by performing inelastic scattering of polarized deuterons on several nuclei. Inelastic cross sections, vector A_y and tensor A_{yy} values were measured at forward angles for different states in C12, Mg24, and Ca40 with 400 MeV polarized deuterons. The shapes of the angular distribution are characteristic of the δL-transfer. The analyzing powers A_y at forward

angles is characteristic of the $\delta S=0$ or 1 transfer. As in (p,p') inelastic scattering, the energy of the 200 MeV/nucleon favors the excitation of $\delta S=1$ transitions relative to the $\delta S=0$ ones. The similarity between these (d,d') results and the (p,p') ones at 200 MeV indicates that a microscopic description of the (d bar, d') scattering in terms of N-N interaction can be undertaken.

35152 (ISN–87-75) **On some recent developments in microscopic nuclear models.** Piepenbring, R. Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires. 1987. 14p. (CONF-8708101–: 6. international symposium on capture gamma-ray spectroscopy, Leuven, Belgium, 31 Aug - 4 sep 1987). Order Number DE89781516/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

An overview of the status of development of some microscopic nuclear models is presented. A special attention is paid to the recent calculations starting from the effective nucleon-nucleon force, to the angular momentum projection method before variation, to the multiphonon method and to the selfconsistent coordinate method. The success and the limitations of the three last mentioned models are illustrated in the example of ^{168}Er.

35153 (ISN–87-96) **Anharmonicities of γ vibrations in ^{168}Er.** Piepenbring, R.; Jammari, M.K. Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires. Dec 1987. 26p. Order Number DE89781501/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The multiphonon method, which is mainly an exact diagonalisation of the total Hamiltonian in the collective space, is applied to the analysis of the γ vibrations in ^{168}Er. The results are compared to those obtained by Dumitrescu and Hamamoto in a perturbation treatment and by Matsuo and Matsuyanagi in the selfconsistent collective coordinate method. It is also explained why the quasiparticle phonon mode of Soloviev strongly overestimates the energies of the two phonons states.

35154 (IYaF–88-79) **Dynamics and statistics of unstable quantum states.** Zelevinskij, V.G.; Sokolov, V.V. AN SSSR, Novosibirsk (USSR). Inst. Yadernoj Fiziki. 1988. 41p. (In Russian). Order Number DE89618985/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Statistical spectrum theory, formulated in terms of arbitrary matrices is generalized into instable states. Statistics of energies and widths as eigenvalues of effective non-Hermitian Hamiltonian is investigated. Under weak mixing of states through the common channels of decay the statistic is described by Wigner formulae for distances between levels and by Porter-Thomas ones- for widths. However, level kindling disappears at the distances smaller than widths. Under strong mixing k of fast decaying states is formed (k is the number of open decay channels). Residual states appear to be long-living. Such reconstruction corresponds to direct process segregation (nuclear analogue of coherent Dicke superradiation). Appearance of cross section Erikson fluctuations is impossible under minor quantity of channels. The case of single-channel scattering is completely analysed. Joint distribution of energies and widths is found under the arbitrary force of external mixing; instable state mean density is obtained. 39 refs.; 3 refs.

35155 (JINR-E–1-88-450) **Nuclear matter excitation in pion-xenon collisions at 3.5 GeV/c. Inclusive spectra of neutral pions.** Pluta, J.; Miller, K.; Pawlak, T.; Peryt, W.; Strugalski, Z. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy. 1988. 12p. Order Number DE89619001/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Inclusive spectra of neutral pions have been analysed in π^- Xe collisions at 3.5 GeV/c in order to obtain data on incident particle energy deposition and nuclear matter excitation at a given value of impact parameter. The results show that two types of secondary pion sources can be distinguished. The first source, with the temperature about 135 MeV, prevails in peripheral collisions but its yield increases when the impact parameter decreases. The second one, with the temperature about 50 MeV, dominates in central collisions. 17 refs.; 9 figs.; 3 tabs.

35156 (JINR-E–4-88-228) **Effect of the particle-particle interaction on the $K^{\pi}=2^+$ states in deformed nuclei.** Solov'ev, V.G.; Shirikova, N.Yu. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics. 1988. 11p. Order Number DE89618986/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Submitted to the journal Izv. Akad. Nauk SSSR, Ser. Fiz.

The effect of the particle-particle interaction on the $K^{\pi}=2^+$ states in even-even deformed nuclei is studied within the random phase approximation. This effect is shown to be considerable at the particle-particle interaction constant $G^{(22)}$ close to the isoscalar constant of the particle-hole interaction $K_0^{(22)}$. 11 refs.; 1 fig.; 3 tabs.

35157 (JINR-R–4-88-509) **Gamow-Teller β^+ decay of neutron-deficient deformed nuclei.** Solov'ev, V.G.; Sushkov, A.V. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics. 1988. 6p. (In Russian). Order Number DE89619037/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Submitted to Phys. Lett., B.

Gamow-teller β^+ decay of even-even deformed nuclei are calculated in the RPA with particle-hole and particle-particle interactions. Insertion of particle-particle interaction results in reduction of total force of (p,n)-transition in 2.5-3 time. Good description of log f-tildet for β^+ decay of ^{162,164,166}Yb and ^{166} Hf at g_A/g_V=-1 and -1.26 is obtained. 10 refs.; 1 tab.

35158 (JINR-R–4-88-612) **Microscopic consideration of d+t -> n+α nuclear reaction within the adiabatic representation.** Vinitskij, S.I.; Dubovik, V.M.; Markovskij, B.L.; Kuperin, Yu.A.; Mel'nikov, Yu.B. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics. 1988. 15p. (In Russian). Order Number DE89619020/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Submitted to the International Seminar Microscopic Methods in a Few Particle System Theory, Kalinin, August 1988, and to J. Phys.

The effective equations for the cluster relative-motion function of the initial and final channels in the nuclear reaction d+t -> n+α are derived within the adiabatic approach. The effective energy-dependent potential is constructed by projecting onto the open channels and its asymptotic behaviour at large intercluster distances is studied. The asymptotic boundary conditions for the effective system of equations in the adiabatic representation are formulated in terms of the known coordinate asymptotics of the microscopic wave function of the five-body system. The relation of these equations with the resonating group model is also considered. 18 refs.; 3 figs.

35159 (KIYI–87-40) **Nuclei form and deformation effect on angular deuteron distribution at elastic and inelastic diffraction scattering.** Evlanov, M.V.; Isupov, V.Yu.; Tartakovskij, V.K. AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij. 1987. 28p. (In Russian). Order Number DE89617853/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The scattering of deuterons by axial and nonaxial soft nuclei in the framework of the diffraction model is considered. No assumption is made requiring the incident deuteron size to be small compared to that of the target nucleus. The effect of double scattering is taking into account as well. Differential cross sections of elastic and inelastic scattering of deuterons are calculated. Comparison of theoretical dependences with the available expermental data is carried out. It is shown that nonsphericity and softness of nucleus as well as the choice of deuteron wave functions essentially affect the cross sections of the interaction. 17 refs.; 10 figs.

35160 (KURRI-TR–303, pp. 24-29) **Recent progress in atomic mass formulas and β-decay gross theory.** Yamada, Masami (Waseda Univ., Tokyo (Japan). Science and Engineering Research Lab.). Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst. May 1988. (In Japanese). (CONF-8801127–: 4. specialist research meeting on measurements of short-lived isotopes, Kyoto, Japan, 12-13 Jan 1988). In *Proceedings of the 4th specialist research meeting on measurements of short-lived isotopes*. Order Number DE89003364/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

The first half of the report focuses on atomic mass formulas which have been developed by the author and his coworkers for accurate representation of the mass of various nuclides at their ground state. The one most frequently used by them is the Uno-Yamada Formula, which consists of two parts representing the

gross behavior and the fluctuations due to each nuclide, or so called shell effect. The latter part is the sum of a proton shell term and a neutron shell term, and may be constant or linear depending on the form of the shell terms. Two new formulas have been derived by incorporating the effect of proton-neutron interaction into the above-mentioned constant-type formula. One of them is different from the constant-type Uno-Yamada Formula in that the shell effect part contains a proton-neutron interaction term. Modification is also made to take into account the coulombic energy. The second half of the report addresses the β-decay gross theory. A modified β-decay gross theory is presented, in which improvements are made to reflect the effect of the UV factor and to meet the sum rules related with the Fermi transition. The monoparticle intensity function is also improved by taking into account solutions of many-body problems related with the sum rules. (N.K.).

35161 (Lund-MPh–87/08) **Shape coexistence in the neutron deficient Pb isotopes and the configuration-constrained shell correction approach.** Bengtsson, R.; Nazarewicz, W. Lund Inst. of Tech. (Sweden). Dept. of Mathematical Physics; Niels Bohr Inst., Copenhagen (Denmark); Politechnika Warszawska, Warsaw (Poland). Inst. Fizyki. Apr 1987. 19p. Order Number DE89783599/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Calculations of shape-isomeric states in neutron deficient lead isotopes have been performed using the configuration-constrained shell correction method with a Woods-Saxon average potential and a monopole pairing interaction. This approach enables us to decompose the ground state potential energy surface in separate parts characterized uniquely by the number of occupied intruder orbitals. The calculations reproduce the positions of the excited 0^+ intruder states. The isotope ^{196}Pb is discussed in detail.

35162 (ORNL/FTR–3277) **[NATO Advanced Study Institute on "The nuclear equation of state,", Peniscola, Spain, May 22–June 3, 1989]: Foreign trip report.** Strayer, M.R. Oak Ridge National Lab., TN (USA). 9 Jun 1989. 3p. Sponsored by DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89014181/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The NATO Advanced Study Institute was a symposium of about 200 scientists from Europe and the US discussing nucleus-nucleus collisions at intermediate and high energies. The sessions were split equally between investigations attempting to learn about the nuclear equation of state, and the more fundamental studies of quantum chromodynamics and the possible formation of the quark-gluon plasma. New data from the AGS and CERN experiments were presented.

35163 (PCCF-T–8811) **Study of the He3 breakup reaction and the triton production spectra at 283 MeV.** Hussain Obid, R. Clermont-Ferrand-2 Univ., 63 - Aubiere (France). Lab. de Physique Corpusculaire. 1988. 131p. (In French). Order Number DE89781524/JAW. Available from NTIS (US Sales Only), PC A07/MF A01.

The breakup of He3 ions at 94MeV/nucleon was studied in inclusive experiments on nuclei ranging from C12 to Pb208, and in coincidence experiments (γd) and (γt) on an A127 target. The inclusive spectra of protons and deuterons show an important contribution of the He3 breakup reaction to the reaction cross section (80%). Analysis of the dependence as a function of A confirms a peripheral mechanism. The coincidence experiment gives a proportion of inelastic breakup in the inclusive cross section of 40 %. Examination of triton spectra reveals that at 94 MeV the dominant reaction is not breakup transfer as at lower energies, but charge exchange. The spectra peak at energies of 20MeV, compatible with the excitation of a mixture of L=1 and L=2 states. The variation of the cross section following an $A^{1/3}$ law indicates a peripheral mechanism for the (He3,t) reaction too. The (γ-t) coincidence reaction showing residual nucleus production near the target nucleus reinforces this result.

35164 ΛN–ΣN *couplingin* $_{\Lambda}^{3}$**H.** Afnan, I. R. (School of Physical Sciences, The Flinders University of South Australia, Bedford Park, South Australia 5042 Australia(AU)); Gibson, B. F. *Physical Review [Section] C: Nuclear Physics (USA),* 40(1): 7-9 (Jul 1989).

Using separable potential equations to model the T=0,J=1/2 ΛNN three-body system, we explore the effects ofΛN–ΣN coupling in the ground state of the hypertriton. ExplicitΛN–ΣN coupling in the hyperon-nucleon interaction is shown toplay a significant role, even in this lightly bound system. When the ΣNchannel is formally eliminated, the dispersive energy dependence of theresulting ΛN effective interaction is repulsive whereas the resultingΛNN three-body force is attractive.

35165 Pseudoscalar πN coupling and relativistic proton-nucleus scattering. Gross, F. (Department of Physics, College of William and Mary, Williamsburg, Virginia 23185(US)); Maung, K. M.; Tjon, J. A.; Townsend, L. W. *Physical Review [Section] C: Nuclear Physics (USA),* 40(1): 10-12 (Jul 1989).

Relativistic p-^{40}Ca elastic scattering observablesare calculated using relativistic NN amplitudes obtained from thesolution of a two-body relativistic equation. Results at 200 MeV are presentedfor three sets of NN amplitudes, two with pure pseudovector coupling forthe pion and one with a 25% admixture of pseudoscalar coupling. Differencesbetween the predictions of these three models provide a measure of theuncertainty in constructing Dirac optical potentials from NN amplitudes.

35166 Production of the H dibaryon in relativistic heavy-ion collisions. Dover, C. B. (Brookhaven National Laboratory, Upton, New York 11973(US)); Koch, P.; May, M. *Physical Review [Section] C: Nuclear Physics (USA),* 40(1): 115-125 (Jul 1989).

We discuss mechanisms for the production of exotic hadrons in heavy-ion collisions at high energy, focusing on the doubly strange H dibaryon. In a hadron gas phase, we estimate the H formation rate, per central Si+Au collision, to be of order 0.01 for temperatures T=120–140 MeV, based on a conventional coalescence model. If the quark-gluon plasma phase is excited, we expect an enhancement relative to the rate for a hadron gas. We explore various schemes for detecting the H in the high multiplicity background characteristic of heavy-ion collisions. The proposed detection techniques include the measurement of weak decays such as $H \rightarrow \Sigma^- p$, the search for nuclear fragments with anomalous charge/mass ratio, and diffractive dissociation processes such as $Hp \rightarrow \Xi^- pp$. .AE

35167 Spin-flip cross sections for $^{13}C(\vec{p},\vec{n})^{13}N$(g.s.) at 500 MeV. Ray, L. (Department of Physics, University of Texas, Austin, Texas 78712(US)); Shepard, J. R. *Physical Review [Section] C: Nuclear Physics (USA),* 40(1): 237-245 (Jul 1989).

It was recently shown that analyzing power data for 500 MeV(p,n) charge exchange from ^{15}N could not beadequately explained by either relativistic or nonrelativistic distorted waveimpulse approximation models. In general, reaction models which incorporaterelativistic dynamics provide a successful description of proton-nucleuselastic scattering at intermediate energies. It is therefore important tounderstand the reasons for the apparent failure of the theoretical models withrespect to the description of (p,n) charge exchange data from oddtargets. In this work a method of analyzing intermediate energy(p,n) reaction data from odd target nuclei is presented whichfocuses attention on specific dynamical elements of the relativistic distortedwave impulse approximation model. Included in these elements are the differentpieces of the Lorentz invariant nucleon-nucleon isovector effective interactionand the aspects of nuclear structure associated with the valence nucleon. Theanalysis utilizes certain linear combinations of the $(\vec{p},\vec{n})$polarization transfer observables, the important quantities being thetransverse and longitudinal spin-flip cross sections and the projectileno-spin-flip cross section. The method is illustrated with relativisticdistorted wave impulse approximation calculations for the$^{13}C(\vec{p},\vec{n})^{13}N$(g.s.) reaction at 500MeV. It is intended that analyses of this type will provide an important toolfor diagnosing the apparent inadequacies with the theoretical description ofintermediate energy (p,n) charge exchange from odd nuclei.

35168 Polarization response functions and the $(\vec{e},e\vec{p})$ reaction. Picklesimer, A. (Physics Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545(US)); Van Orden, J. W. *Physical Review [Section] C: Nuclear Physics (USA),* 40(1): 290-303 (Jul 1989).

The first comprehensive study of the full set of 18 response functionsrelevant to the $(\vec{e},e\vec{p})$ reaction is presented. Benchmarkanalytical features and limiting cases of the response functions are described.Numerical predictions contrasting nonrelativistic and relativistic (Dirac)dynamics and on- and off-shell final-state interaction effects are presented.Basic physical characteristics and dependences of the response functions areidentified. The outlook for future experimental studies of the$(\vec{e},e\vec{p})$ polarization response functions is discussed.

35169 Two-loop corrections for nuclear matter in the Walecka model. Furnstahl, R. J. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742(US)); Perry, R. J.; Serot, B. D. *Physical Review [Section] C: Nuclear Physics (USA),* 40(1): 321-353 (Jul 1989).

Two-loop corrections for nuclear matter, including vacuum polarization, arecalculated in the Walecka model to study the loop expansion as an approximationscheme for quantum hadrodynamics. Criteria for useful approximation schemes arediscussed, and the concepts of strong and weak convergence are introduced. Thetwo-loop corrections are evaluated first with one-loop parameters and meanfields and then by minimizing the total energy density with respect to thescalar field and refitting parameters to empirical nuclear matter saturationproperties. The size and nature of the corrections indicate that the loopexpansion is not convergent at two-loop order in either the strong or weaksense. Prospects for alternative approximation schemes are discussed.

35170 Wave function of ^{14}N. Amos, K. (School of Physics, The University of Melbourne, Parkville, Victoria, 3052 Australia(AU)); Koetsier, D.; Kurath, D. *Physical Review [Section] C: Nuclear Physics (USA),* 40(1): 374-381 (Jul 1989).

The β- and γ-decay rates, electron scattering form factors,and intermediate energy (p,p') and ($\mathbf{p},n$)cross-section data are used to compare a set of wave functions that have beenproposed for ^{14}N. With pertinent reaction t matrices andallowance for reasonable and often small core polarization corrections the wavefunctions derived by standard (shell-model) calculations are found to be themost relevant.

35171 Finite nucleus Dirac mean field theory and random phase approximation using finite *B* splines. McNeil, J. A. (Department of Physics, Colorado School of Mines, Golden, Colorado 80401(US)); Furnstahl, R. J.; Rost, E.; Shepard, J. R. *Physical Review [Section] C: Nuclear Physics (USA),* 40(1): 399-406 (Jul 1989).

We calculate the finite nucleus Dirac mean field spectrum in a Galerkinapproach using finite basis splines. We review the method and present resultsfor the relativistic σ-ω model for the closed-shell nuclei^{16}O and ^{40}Ca. We study the convergence of themethod as a function of the size of the basis and the closure properties of thespectrum using an energy-weighted dipole sum rule. We apply the method to theDirac random-phase-approximation response and present results for the isoscalar1^- and 3^- longitudinal form factors of^{16}O and ^{40}Ca. We also use a *B*-splinespectral representation of the positive-energy projector to evaluate partialenergy-weighted sum rules and compare with nonrelativistic sum rule results.

35172 Coriolis coupling in the rotational bands of deformed odd-odd nuclei. Jain, A. K. (Florida State University, Tallahassee, Florida 32306(US)); Kvasil, J.; Sheline, R. K.; Hoff, R. W. *Physical Review [Section] C: Nuclear Physics (USA),* 40(1): 432-444 (Jul 1989). DOE Contract W-7405-ENG-48.

Evidence is presented for the existence of odd-even staggering inK^- rotational bands (with $K>0$) of odd-odd nuclei in therare-earth and actinide regions. Coriolis-coupling calculations have beencarried out for rotational bands in ^{168}Tm,^{176}Lu, ^{182}Ta, and ^{182}Re.With these calculations, we are able to reproduce the odd-even staggeringobserved in these nuclei. In particular, the unusually strong staggeringobserved in the $K=2^+$ and 4^- bands of^{182}Re can be understood. Unusual features in the wavefunctions of some bands reflect the importance of couplings due to terms otherthan Coriolis in the Hamiltonian.

35173 Large-N_c QCD, composite nucleons, and the Dirac sea. Cohen, T. D. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742(US)). *Physical Review Letters (USA),* 62(26): 3027-3030 (26 Jun 1989).

It is shown that one-nucleon-loop calculations of the vacuum contributions to the effective potential for hadronic field theories with point nucleon fields are not compatible with large-N_c QCD. One expects that nucleon substructure will lead to a suppression of such effects of at least order N_c^{1-d}, where d is the dimension of spacetime. Issues of the self-consistency of the large-N_c QCD are discussed.

6540 Radiation and Shielding Physics

Refer also to citation(s) 34342, 35035, 35148

35174 (CTH-RF–60) **Eigenvalues of one-speed neutrons in finite slabs.** Sjoestrand, N.G. Chalmers Univ. of Tech., Goeteborg (Sweden). Dept. of Reactor Physics. Sep 1988. 10p. Order Number DE89617842/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

The criticality factor has been determined for finite slabs. assuming neutrons of one speed scattering isotropically. The finite extension of the slab in two dimensions was taken into account by the buckling approximation. Numerical values are given of the criticality factor as a function of the thickness and lateral buckling. For the corresponding time-dependent case the decay constant has also been calculated.

35175 (IC–88/415) **Energy dependent transport problem with generalized boundary conditions.** El Wakil, S.A.; Attia, M.T.; Abdel Krim, M.S.; El Ghazaly, A.A. International Centre for Theoretical Physics, Trieste (Italy). Dec 1988. 18p. Order Number DE89617843/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The slowing down of the Boltzmann Equation for generalized boundary conditions is considered and transformed into one speed equation in Laplace space. Exact relations between energy reflection and transmission coefficients for a problem with diffuse reflecting boundary conditions and the albedos for the problem with isotropic boundary conditions are obtained. The Galerkin method is used to calculate the energy reflection coefficient for a finite slab at different thicknesses for different mass ratios A, target to projectile mass ratio, for different synthetic scattering kernels. The methods for partial heat fluxes for isotropic and anisotropic scattering in dispersive medium are given. The results obtained for isotropic boundary conditions are compared well with the exact results. (author). 16 refs, 4 tabs.

35176 (INIS-SU–74/A, pp. 35-44) **Numerical algorithm and program for calculating group build up factors.** Sholokhova, V.A. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR). 1987. (In Russian). In *Methods and programs for numerical solution of the mathematical physics problems. Scientific-technical collection.* Order Number DE89012113/JAW. Available from NTIS (US Sales Only), PC A05/MF A01; INIS.

Voprosy atomnoj nauki i tekhniki.; no. 2.

Solution of one particular problem of γ-radiation transport with deviation of group built-up factors as a final result is described. The problem is solved numerically using the method of moments. The metodical part include the formation of numerical algorithm of solution of transport equation with respect to the moments of distribution function and reduction of flux function (intensity) according to determined moments. The practical part of the problem includes writing of the program of numerical solution and computer calculation. The program is written in Fortran-4 algorithmic language for BESM-6 computer. 9 refs.; 12 tabs.

35177 (INIS-SU–74/A, pp. 45-56) **Program for calculation of electron trajectories in an infinite homogeneous medium by the Monte Carlo method.** Donskoj, E.N.; Ivanov, N.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i

Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR). 1987. (In Russian). In *Methods and programs for numerical solution of the mathematical physics problems. Scientific-technical collection.* Order Number DE89012113/JAW. Available from NTIS (US Sales Only), PC A05/MF A01; INIS.

Voprosy atomnoj nauki i tekhniki.; no. 2.

Consideration is given to be algorithm and the body of EhTR program of simulating electron trajectories in an infinite homogeneous medium by the Monte Carlo method. The algorithm is based on Fokker-Planck approximation for describing gazing collisions. The main feature of the algorithm lies in the fact that its realization doesn't require preliminary tabulation of any distribution. Results of comparative calculations, supporting the EhTR program operationability are presented. 16 refs.; 6 figs.

35178 (INIS-SU–77/A, pp. 56-59) **Experimental determination of mean square radius of electric charge distribution in neutron.** Aleksandrov, Yu.A. (Joint Inst. for Nuclear Research, Dubna (USSR)); Vrana, M.; Machekhina, T.A.; Sedlakova, L.N. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij. 1988. (In Russian). (CONF-870959–: 1. international conference on neutron physics, Kiev, USSR, 14-18 Sep 1987). In *Neutron physics. Vol. 1.* Order Number DE89780087/JAW. Available from NTIS (US Sales Only), PC A19/MF A01; INIS.

Two independent experiments were carried out: neutron diffraction experiment on tungsten crystals and measurement of the energy dependence of the total neutron cross section of bismuth. They gave the mean square radius of the neutron $<r_{in}^2>_n^{1/2}=(0.11\pm0.02)$fm. The obtained value is compared with that calculated in the frame of the bag model. 10 refs.; 1 fig.

35179 (INIS-SU–77/A, pp. 168-175) **Diffuse neutron scattering on statistical inhomogeneities in monocrystals.** Abov, Yu.G. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Teoreticheskoj i Ehksperimental'noj Fiziki); Elyutin, N.O.; Ehjdlin, A.O. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij. 1988. (In Russian). (CONF-870959–: 1. international conference on neutron physics, Kiev, USSR, 14-18 Sep 1987). In *Neutron physics. Vol. 1.* Order Number DE89780087/JAW. Available from NTIS (US Sales Only), PC A19/MF A01; INIS.

Space and angular distribution of the diffuse scattered neutrons on the high-perfect crystals are investigated. In real crystals thermal vibrations and defects distort crystal lattice, violating coherent relation of secondary waves. It results in the weakening of interference effects or in their utter elimination, the change in angular and spatial distribution of diffracted radiation intensity and also in the appearance of diffuse scattering. The distribution of diffuse scattering intensity in the space of momentum transfer vectors permits to determine the type of defects (implanted or vacancy one), their symmetry and dimensions. 5 refs.; 5 figs.

35180 (INIS-SU–78, pp. 322-330) **Measurement of neutron distribution in energy and in probability of interaction with matter in transmission experiment with reactor beam.** Filippov, V.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (USSR). Fiziko-Ehnergeticheskij Inst.); Tarasko, M.Z. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij. 1988. (In Russian). (CONF-870959–: 1. international conference on neutron physics, Kiev, USSR, 14-18 Sep 1987). In *Neutron physics. Vol. 2.* Order Number DE89012115/JAW. Available from NTIS (US Sales Only), PC A16/MF A01; INIS.

Neutron transmission with a reactor beam through polyethylene and samples of construction materials is used for spectra reconstruction of unreacted neutrons and moments of cross section distribution on the spectra of different regidity. 5 refs.; 5 tabs.

35181 (ISN–87-95) **Excitation of giant dipole modes in heavy-ion reactions.** Suraud, E.; Pi, M.; Schuck, P. Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires. Nov 1987. 17p. (CONF-8709200–: 1. topical meeting on giant resonance excitation in heavy-ion collisions, Legnaro, Italy, 21-25 Sep 1987). Order Number DE89781518/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

A study of the excitation of giant dipole modes during heavy-ion reactions is presented within the framework of a complete (non linearized) Vlasov equation. It is found that, in the entrance channel, a giant dipole motion is responsible for the charge equilibration process in the fused system. The phonon energies corresponding to this mode are in agreement with what is expected for excited, rotating, deformed giant dipole oscillations.

35182 (KEK–88-3) **1st KEK symposium on ultra cold neutrons (UCN).** Yoshiki, H. (ed.). National Lab. for High Energy Physics, Oho, Ibaraki (Japan). Jun 1988. 174p. (CONF-8803216–: 1. KEK symposium on ultra cold neutrons (UCN), Tsukuba, Japan, 10 Mar 1988). Order Number DE89012146/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

Individual papers are processed separately for the data base. (DLC)

35183 (KEK–88-3, pp. 66-82) **New development of neutron spectral modulation data analysis.** Ito, Y. (Tokyo Univ. (Japan). Inst. for Solid State Physics). National Lab. for High Energy Physics, Oho, Ibaraki (Japan). Jun 1988. (CONF-8803216–: 1. KEK symposium on ultra cold neutrons (UCN), Tsukuba, Japan, 10 Mar 1988). In *1st KEK symposium on ultra cold neutrons (UCN).* Order Number DE89012146/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

A study is made on procedures for obtaining desired scattering function information. The neutron spectral modulation technique incorporates both the low (including DC) and high frequency Fourier components in its incident spectrum. Lake's procedure increases the Fourier components of the doconvoluted scattering function by using the existing Fourier components as nucleus, thereby bridges the Fourier gap and extends the Fourier region. Since the Lake's procedure takes care of the missing Fourier components, a single measurement using an appropriate NSM modulation suffices to recover the S(W) line shape. Deep modulation depth is not essential to reproduce the scattering function. This should be contrasted to the previous NSM treatment as well as to the neutron spin echo method, both of which require the several repeat of measurements with the varying modulation frequency under the high degree of beam polarization condition. Although the computer simulation of the present paper does not include the statistical fluctuation encountered in the experimental data, these analyses show a great promise of the NSM method, which can now be used with much flexibility in the field of both cold and ultracold neutron scattering experiment. (N.K.).

35184 (KEK–88-3, pp. 103-110) **Neutron life time measurement by the Serebrov's sphere.** Yoshiki, H. (National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan)). National Lab. for High Energy Physics, Oho, Ibaraki (Japan). Jun 1988. (CONF-8803216–: 1. KEK symposium on ultra cold neutrons (UCN), Tsukuba, Japan, 10 Mar 1988). In *1st KEK symposium on ultra cold neutrons (UCN).* Order Number DE89012146/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

In the last International Conference on Neutron Physics in Kiev, 1987, A.P. Serebrov announced his intention to measure the neutron life time with ultra cold neutrons (UCN) by means of a device, in which a sphere with a horizontal rotation axis has a circular window on the great circle perpendicular to the axis. Serebrov did not mention how this instrument was operated. The present note concerns with this point. Firstly why is it spherical? Because UCN stored in it will not suffer energy transfer from its wall and their spectrum would not change. This should be the most important feature of the device and the sphere might as well be replaced by a horizontal cylinder in principle. Secondly imagine UCN jumping around in the gravitational field in the sphere. The number of reflections in a certain time will be a function of the maximum potential energy averaged over the UCN contained in the sphere. The number of the UCN on the other hand is reduced by reflection from the wall during this time. The UCN life time measurement can be much improved compared with the conventional free neutron life time measurement. According to calculations based on some assumptions, it is at least in principle very likely that the accuracy of

neutron life time can be improved by means of UCN with the ingenious device proposed by Serebrov. (N.K.).

35185 (KEK–88-3, pp. 130-136) **KEK-Mark 3000 UCN production system.** Ishimoto, Shigeru (National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan)). National Lab. for High Energy Physics, Oho, Ibaraki (Japan). Jun 1988. (In Japanese). (CONF-8803216–: 1. KEK symposium on ultra cold neutrons (UCN), Tsukuba, Japan, 10 Mar 1988). In *1st KEK symposium on ultra cold neutrons (UCN).* Order Number DE89012146/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

An He^3 cryostat for UCN production has been installed in the KEK neutron scattering facilities. Cooling test of the cryostat has recently been accomplished successfully with an UCN bottle temperature of 0.76 K reached. The report outlines the construction of the cryostat and describes major results of the cooling test. The equipment has a L-shape so that it can be placed close to the cold neutron source. The target portion has a capacity is 15 l, the greatest among the cryostats below 1 K in the world. Its design ensures a reduced consumption of liquid helium and liquid nitrogen as well as improved basic performance. For the testing, cooling is performed with liquid nitrogen, followed by liquid helium, 1 K cooling, pure He^4 and then He^3. Measurements are made of temperature, liquid level, and cooling power. The temperature distribution in the heat exchanger is calculated. It is demonstrated that stable operation is possible at the He^3 temperature of 0.44 K, permitting physical experiments in a 3 m bottle. The cryostat requires 3~4 days of pre-cooling, with a liquid helium consumption of about 300 l. Liquid consumption during stationary operation is 2.0 l/hr. The bottle temperature can be measured accurately. Observations of temperature difference between the UCN bottle and He^3 are interpreted by simulation. (N.K.).

35186 (OEVS-Mitteilung–1988, pp. 625-629) **Axial distribution of absorbed doses in fast neutron field at the RB reactor.** Sokcic-Kostic, M. (Institut za Nuklearne Nauke Boris Kidric, Belgrade (Yugoslavia)); Pesic, M.; Antic, D.; Ninkovic, M. Oesterreichischer Verband fuer Strahlenschutz (OeVS), Vienna (Austria). Nov 1988. (CONF-860969–: 4. European congress and 13. regional congress of the International Radiation Protection Association, Salzburg, Austria, 15-19 Sep 1986). In *4. European congress and 13. regional congress of IRPA. 20 years experience in radiation protection - a review and outlook.* Order Number DE89613806/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

The coupled fast thermal system CFTS at the RB reactor is created for obtaining fast neutron fields. The axial distribution of fast neutron flux density in its second configuration (CFTS-2) is measured. The axial distribution of absorbed doses is computed on the basis of mentioned experimental results. At the end these experimental and computed results are given. 6 refs., 3 figs., 1 tab.

35187 **Development of a cone-geometry positron moderator.** Lynn, K. G. (Brookhaven National Laboratory, Upton, New York 11973(US)); Gramsch, E.; Usmar, S. G.; Sferlazzo, P. *Applied Physics Letters (USA),* 55(1): 87-89 (3 Jul 1989). DOE Contract AC02-76CH00016.

Results are presented on a new cone-shaped positron moderator which shows a high moderator efficiency (i.e., conversion of beta decay to emitted slow positrons). The moderator efficiencies for the cone moderators studied were found to be up to 0.14% compared to thin-foil measurements of 0.06% in the same experimental system including identical source and holder. These moderators are rugged and easily fabricated, however, they have a lower brightness than single-crystal foil moderators. Comparison of various geometries is presented as well as suggestions for further improvements to increase the total efficiencies.

35188 **Barkas effect with use of antiprotons and protons.** Gabrielse, G. (Department of Physics, Harvard University, Cambridge, Massachusetts 02138(US)); Fei, X.; Orozco, L. A.; Rolston, S. L.; Tjoelker, R. L.; Trainor, T. A.; Haas, J.; Kalinowsky, H.; Kells, W. *Physical Review [Section] A: General Physics (USA),* 40(1): 481-484 (1 Jul 1989).

The difference in the range of protons and antiprotons in matter, anexample of the Barkas effect, is observed in a simple time-of-flight apparatus.The ranges of 5.9-MeV antiprotons and protons differ by about 6% in a degradermade predominantly of aluminum.

6550 Medical Physics

Refer also to citation(s) 33329, 33586, 34151, 34284, 34692, 34697, 34698, 34699

35189 (AECL–8408) **Study on the health of the employees of Atomic Energy of Canada Limited. III. Upgrading the data base.** Johnston, L.H.; Werner, M.M. Atomic Energy of Canada Ltd., Pinawa, MB (Canada). Whiteshell Nuclear Research Establishment. 1987. 26p. Order Number DE89619935/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The Atomic Energy of Canada Ltd (AECL) Employee Health Study commenced in 1980 July following the issue of a Company-Wide General Notice of 1980 April by the President of Atomic Energy of Canada Limited, Mr. James Donnelly. The study was set up to determine the causes of death of the AECL study population as compared to a similar group in the general population and to determine if there is a relationship between cause of death and occupational exposure to ionising radiation. Previous AECL reports have outlined how the study has been set up and implemented. The purpose of this report is to describe the reasons for and the methods of upgrading the data base for the AECL Employee Health Study. Some description of procedures used during the first linkage and recommendations for future linkages are included.

35190 (CNEN-NE–3-05) **Requirements of radiation protection and safety for nuclear medicine services.** Comissao Nacional de Energia Nuclear, Rio de Janeiro, RJ (Brazil). 1989. 17p. (In Portuguese). Order Number DE89618064/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The requirements of radiation protection and safety for nuclear medicine services are established. The norms is applied to activities related to the radiopharmaceuticals for therapeutics and 'in vivo' diagnostics purposes. (M.C.K.).

35191 (IBK–1602) **SI unit for exposure - suggestion for the name, symbol and definition.** Ninkovicj, M. Institut za Nuklearne Nauke Boris Kidric, Belgrade (Yugoslavia). 1985. 7p. Order Number DE89618135/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Of all SI radiation quantities, only the exposure unit remains unnamed. The authors have proposed a name, symbol and definition for this quantity. Relationships among some radiation quantities for X- and gamma-rays in air and conversion factors from old into new units are given. (author). 10 refs.; 1 tab.

35192 (INIS-BR–1516, pp. 7) **Interface dose distribution between irradiated medium with photons.** Silva, J.G. da (Instituto Portugues de Oncologia, Lisboa). Sociedade Brasileira de Cancerologia, Salvador, BA (Brazil). 1988. (In Portuguese). (CONF-8810366–: 2. Iberian-American congress of oncology, Salvador, Brazil, 9-14 Oct 1988). In *Proceedings of the 2. Iberian-American Congress of Oncology.* Order Number DE89613927/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

RADIATION DOSE DISTRIBUTIONS/thermoluminescent dosimetry; COBALT 60; GAMMA RADIATION; PHOTONS; TISSUE-EQUIVALENT MATERIALS

35193 (JINR–16-88-524) **Experimental determination of the influence of an ionization chamber wall material on the chamber sensitivity in high energy particle beams.** Zielczynski, M.; Molokanov, A.G.; Cherevatenko, E.P. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems. 1988. 5p. (In Russian). Order Number DE89619956/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Influence of an atomic composition of material surrounding the gas cavity on gas ionization has been investigated in medical beams of protons with the energy of 200 MeV and 660 MeV and neutrons with mean energy of 350 MeV. Data obtained permit to calculate the correction factors required for determination of dose absorbed in a phantom by means of real detectors. It is shown that corrections may be neglected for ionization chambers with organic material walls. 5 refs.; 2 figs.; 1 tab.

35194 (LHRL-LIB/Trans–3) **Dose limits.** Fitoussi, L. Australian Nuclear Science and Technology Organisation, Lucas Heights (Australia). Dec 1987. 34p. Order Number DE89618065/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Translated from CEA Clefs (Jul 1987) no. 6 p. 22-33.

The dose limit is defined to be the level of harmfulness which must not be exceeded, so that an activity can be exercised in a regular manner without running a risk unacceptable to man and the society. The paper examines the effects of radiation categorised into stochastic and non-stochastic. Dose limits for workers and the public are discussed.

35195 (MRP/MRL–84-60(TR)) **Radon (thoron) daughter personal alpha-dosimeter of the passive type using a diffused-junction detector and an electrostatic collector.** Bigu, J.; Frattini, A. Canada Centre for Mineral and Energy Technology, Ottawa, ON (Canada). Mining Research Labs. May 1984. 30p. Order Number DE89619957/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A solid-state alpha-dosimeter has been designed and found to be suitable for personal and environmental radon-thoron daughter monitoring. The dosimeter basically consists of an electrostatic collector and an alpha-particle counting system with spectroscopy capabilities. The sensitive volume (~20 cm^3) of the electrostatic collector consists of a cylindrically-shaped metal wire screen and a diffused-junction silicon alpha-detector covered with a thin aluminized mylar sheet. A DC voltage (~450 V) is applied between the wire screen and the mylar sheet, the latter held at negative potential relative to the metal screen. Data can be retrieved during or after sampling by means of a micro-computer (Epson HX20) via a RS-232 communcation interface unit. The dosimeter has been calibrated in a large (26 m^3) radon/thoron test facility. A linear relationship was found between radon gas concentration and radon daughter Working Level, and the dosimeter's alpha-count. The dosimeter is mounted on top of an ordinary miner's cap lamp battery and is ideally suited for personal monitoring in underground uranium mines and other working areas. The dosimeter presented here is a considerably improved version of an earlier prototype.

35196 (NKS–88-7, pp. 4) **Dispersion of radioactivity within the reactor radioactive effluents dispersion and environmental effects' AKTI-100 and AKTU-200.** Kilpi, K. (VTT (Finland)). Nordisk Kontaktorgan for Atomenergispoergsmaal, Risoe (Denmark). Nov 1988. (In Swedish). In *Nordic projects concerning nuclear safety. Report for January-June 1988.* Order Number DE89618061/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Survey of the "state-of-the art" and of research activities within the field of radioactivity inside the reactor itself, including aerosol transport, chemistry, sensitivity studies and coordination of research activities. (AB).

35197 (NRPB-R–227) **Radiation exposure of the UK population - 1988 review.** Hughes, J.S.; Shaw, K.B.; O'Riordan, M.C. National Radiological Protection Board, Chilton (UK). Mar 1989. 98p. Available from H.M. Stationery Office, London, price Pound 7.00.

This is the fourth review in 14 years and reflects radiological conditions in the late 1980s. The main conclusions are: (a) the annual dose, averaged over the whole population, is about 2.5 mSv in total; (b) some 87% of the total is from natural radiation with half from radon exposure indoors; (c) medical exposure of patients accounts for 12% of the total; (d) all other artificial sources - nuclear discharges, fallout, miscellaneous and occupational - account for 1% of the total. The radiological, as opposed to the sociological, impact on the UK of the Chernobyl reactor accident was slight.

35198 (OEVS-Mitteilung–1988, pp. 77-80) **Instructor kit to demonstrate basic radiation protection.** Boeck, H. (Atominstitut der Oesterreichischen Universitaeten, Vienna (Austria)); Hammer, J. Oesterreichischer Verband fuer Strahlenschutz (OeVS), Vienna (Austria). Nov 1988. (CONF-860969–: 4. European congress and 13. regional congress of the International Radiation Protection Association, Salzburg, Austria, 15-19 Sep 1986). In *4. European congress and 13. regional congress of IRPA. 20 years experience in radiation protection - a review and outlook.* Order Number DE89613806/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

A suitcase containing all the necessary equipment to perform twelve simple but most instructive experiments with two small radiation sources is described. Its main aim is to assist persons involved in students education in the field of radiation protection or nuclear physics, to set up the experiments in the most instructive way to explain the physics background and to discuss the results. The hardware is described and the twelve experiments listed. 1 fig. (qui).

35199 (ORNL/FTR–3278) **[Tenth symposium on microdosimetry, Rome, Italy; Department of Energy/Commission of European Communities workshop, Rome, Italy; and visit to Neuherberg, W. Germany, May 21–June 3, 1989]: Foreign trip report.** Wright, H.A. Oak Ridge National Lab., TN (USA). 15 Jun 1989. 7p. Sponsored by DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89014751/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Report of Harvel A. Wright, to participate in the Tenth Symposium on Microdosimetry in Rome, Italy, May 21-26, 1989; to participate in a Department of Energy/Commission of European Communities (DOE/CEC) Workshop on Long-Term Research Needs and Priorities in Microdosimetry, held in Rome following the microdosimetry symposium; and to visit the Gesellschaft fur Strahlen- and Umweltforschung (GSF) in Neuherberg, FRG, to carry out collaborative research with Dr. H.G. Paretzke.

35200 (SSI–88-10) **Nuclear power industry, -activity discharge, -occupational exposures. Third quater of the year 1987.** National Inst. of Radiation Protection, Stockholm (Sweden). 19 May 1988. 32p. (In Swedish). Order Number DE89618071/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Operations during the quarter: Several plants were revised. Less energy demand during summer half and revisions have implied a lower factor of utilization than during winter half. Discharges during the quarter: Discharge from all plants were low. The discharges are less then 1% of standards for permitted discharges considering individual doses, with exception for Ringhals, where the discharge is about 4% of standards. Occupational exposures during the quarter: No personnel in radiological work at the nuclear power plants, Asea-Atom or Studsvik received a dose exceeding the quarter dose limit, 30 mSv. No personnel in radiological work was internally contaminated by radioactive substances in contents exceeding 0.5% of the limit for the yearly ingestion of radioactive substances. The reporting limit to SSI is 0.5%. (O.S.).

6560 Condensed Matter Physics

Refer also to citation(s) 33695, 33854, 33856, 33857, 33858, 33938, 33976, 34008, 34022, 34023, 34024, 34127, 34305, 34907, 34908, 34910, 35127, 35179, 35242, 35285, 35306, 35307, 35313, 35314, 35315, 35316, 35317, 35318, 35330, 35331, 35332, 35335, 35361

35201 (DOE/ER/45265–T3) **[Magnetic properties of sputtered films]: Progress report, August 1, 1986–July 31, 1989.** Cadieu, F.J. Queens Coll., Flushing, NY (USA). Dept. of Physics. 17 Jan 1989. 14p. Sponsored by DOE Energy Research. DOE Contract FG02-86ER45265. Order Number DE89013510/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This paper discusses the following topics: high $_{\perp}H_c$ perpendicular anisotropy $Nd_2Fe_{14}B$ films; high $_{\perp}H_c$ films that exhibit in-the-film-plane anisotropy; election energy loss results on $SmCo_5$ and $Nd_2Fe_{14}B$; thick high energy films of $Sm_2(Co,Fe,Zr)_{17}$; high coercive force Sm-Ti-Fe film samples; and synthesis of $R(Ti,Fe)_{12}$(R = Nd,Sm) compound. (LSP)

35202 (GANIL-A–88-02) **Beam foil interaction studies for the future stripper of Ganil.** Baron, E.; Ricaud, C. Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France). 1988. 3p. (CONF-880695–: 1. European Particle Accelerator Conference (EPAC-1), Rome, Italy, 7-11 Jun 1988). Order Number DE89781543/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

The GANIL 3 - cyclotron accelerator complex is to be upgraded in 1989 by increasing the beam energy at the stripper. In view of this modification, the effect of carbon stripper foils of various thicknesses (from 50 to 250 $\mu g/cm^2$) on the energy spread of Ar, Kr, Xe and Ta

beams was measured using the analysing section of the 270^0 spectrometer. Energies ranging from 3.2 to 6.5 MeV/A (i.e corresponding to the future energy range) were used, and intensities of several hundreds of electrical nanoamperes were concentrated over a few mm^2 spot. Unusually large values of the additional energy spread are reported. In addition, charge state distributions of the 6.48 MeV/A Xe and 4.81 MeV/A Ta beams were measured as a function of the carbon thickness, in order to be able to choose how close to the equilibrium thickness the stripper should be, while keeping the energy spread of the outgoing beams within reasonable limits.

35203 (IAE–4677/1) **Passage of ultrarelativistic electrons through real crystals.** Starostin, V.A. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Atomnoj Ehnergii. 1988. 5p. (In Russian). Order Number DE89618624/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

A theory has been developed on passage of fast charged particles through single crystals of any nature. Necessity of allowance for defect influence in choosing the crystal, the source of directional radiation, is shown. 5 refs.

35204 (IC–88/289) **Thermodynamics of two component gaseous and solid state plasmas at any degeneracy.** Kraeft, W.D.; Stolzmann, W.; Fromhold-Treu, I.; Rother, T. International Centre for Theoretical Physics, Trieste (Italy). Oct 1988. 12p. Order Number DE89617620/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

We give the results of thermodynamical calculations for two component plasmas which are of interest for dense hydrogen, noble gas and alkali plasmas and for electron hole plasmas in optically excited semiconductors as well. 25 refs, 4 figs.

35205 (IC–88/291) **Theoretical study of the interplay of electron-electron interaction and disorder.** Brezini, A.; Behilil, S. International Centre for Theoretical Physics, Trieste (Italy). Oct 1988. 14p. Order Number DE89617600/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A disordered Hubbard model with diagonal disorder is used to investigate the electron localization effects associated with both disorder and electron-electron interaction. Extensive results are reported on the ground state properties and compared to other theories. Two regimes have been found: when the electron-electron interaction u is greater than the disorder parameter w and when u < w. (author). 18 refs, 4 figs.

35206 (IC–88/376) **Pressure effects on Ge and Si, A simplified tight binding approach.** Tuncay, C. International Centre for Theoretical Physics, Trieste (Italy). Dec 1988. 7p. Order Number DE89617601/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

A simplified version of Empirical Tight Binding Method is used to predict the effects of hydrostatic pressure on Ge and Si bands. The method does not involve band structure calculations but gives equivalent results, which mimic some experimental outcome. (author). 13 refs, 1 fig., 1 tab.

35207 (IC–88/421) **Thermal stability between rotating cylinders in a radially symmetrical gravitational field.** Bestman, A.R. International Centre for Theoretical Physics, Trieste (Italy). Dec 1988. 6p. Order Number DE89618548/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

The paper considers the flow in a porous medium confined between two rotating heated cylinders in a radially symmetrical gravitational field. Particular attention if focussed on the critical point for the onset of instability. The effect of porosity and heating on the stability boundary is discussed quantitatively. The results of this work are important to geophysics. (author). 8 refs, 1 tab.

35208 (IFUSP-P–703) **Optical absorption study of radiation and thermal effects in Brazilian samples of spodumene.** Isotani, S.; Fujii, A.T.; Antonini, R.; Furtado, W. Sao Paulo Univ., SP (Brazil). Inst. de Fisica. Mar 1988. 57p. Order Number DE89618625/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

A detailed analysis of the optical absorption spectra of five varieties of Brazilian spodumene is presented. The samples were submitted to heat treatments and irradiated with gamma rays, x radiation, electrons and ultraviolet light. (M.C.K.).

35209 (INIS-BR–1483, pp. 16) **Molecular beam epitaxy of gallium arsenide on silicon substrate.** Carvalho, R.P. de (Minas Gerais Univ., Belo Horizonte (Brazil). Dept. de Fisica); Bezerra, J.C.; Dias, I.F.L. and others. Minas Gerais Univ., Belo Horizonte (Brazil). Dept. de Fisica. 1989. (In Portuguese). (CONF-8901126–: 4. Brazilian school of semiconductor physics, Belo Horizonte, Brazil, 23 Jan - 3 feb 1989). In *Proceedings of the 4. Brazilian School of Semiconductor Physics.* Order Number DE89612194/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

EPITAXY/crystal growth; EPITAXY/gallium arsenides; EPITAXY/molecular beams; MOLECULAR BEAMS/crystal growth; MOLECULAR BEAMS/epitaxy; MOLECULAR BEAMS/gallium arsenides; SILICON/crystal growth; SILICON/substrates; CORROSION; EPITAXY; OXIDATION; RAMAN SPECTRA; RUTHERFORD SCATTERING; SILICON; SUBSTRATES; TEMPERATURE DEPENDENCE; THERMOLUMINESCENCE

35210 (INIS-BR–1483, pp. 25) **Optical and structural properties of CdTe films growth on GaAs and Si substrates.** Mendonza A, J.G. (Instituto Politecnico Nacional, Mexico City (Mexico). Centro de Investigacion y de Estudios Avanzados); Zelaya, O.; Torres D, G.; Sanchez S, F. Minas Gerais Univ., Belo Horizonte (Brazil). Dept. de Fisica. 1989. (CONF-8901126–: 4. Brazilian school of semiconductor physics, Belo Horizonte, Brazil, 23 Jan - 3 feb 1989). In *Proceedings of the 4. Brazilian School of Semiconductor Physics.* Order Number DE89612194/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

CADMIUM TELLURIDES/crystal growth; CADMIUM TELLURIDES/films; CRYSTAL STRUCTURE/films; GALLIUM ARSENIDES/substrates; OPTICAL PROPERTIES/films; SILICON/substrates; FILMS; SUBSTRATES; PHOTOLUMINESCENCE; SCANNING ELECTRON MICROSCOPY; SILICON; X-RAY DIFFRACTION

35211 (INIS-BR–1483, pp. 26) **Optical characterization of microcrystalline CdTe thin films.** Melendez L, M. (Instituto Politecnico Nacional, Mexico City (Mexico). Centro de Investigacion y de Estudios Avanzados); Jimenez S, S.; Hernandez C, I. Minas Gerais Univ., Belo Horizonte (Brazil). Dept. de Fisica. 1989. (CONF-8901126–: 4. Brazilian school of semiconductor physics, Belo Horizonte, Brazil, 23 Jan - 3 feb 1989). In *Proceedings of the 4. Brazilian School of Semiconductor Physics.* Order Number DE89612194/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

CADMIUM TELLURIDES/annealing; CADMIUM TELLURIDES/thin films; THIN FILMS/crystal growth; THIN FILMS/optical properties; THIN FILMS/x-ray diffraction; ABSORPTION; ABSORPTION SPECTROSCOPY; ANNEALING; MICROSTRUCTURE; REFRACTIVITY; SPUTTERING; THICKNESS

35212 (INIS-BR–1483, pp. 42) **Vertical transport in superlattices using Kubo formalism.** Davidovich, M.A. (Pontificia Univ. Catolica do Rio de Janeiro, RJ (Brazil). Dept. de Fisica); Anda, E.V. Minas Gerais Univ., Belo Horizonte (Brazil). Dept. de Fisica. 1989. (CONF-8901126–: 4. Brazilian school of semiconductor physics, Belo Horizonte, Brazil, 23 Jan - 3 feb 1989). In *Proceedings of the 4. Brazilian School of Semiconductor Physics.* Order Number DE89612194/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

SUPERLATTICES/electric conductivity; SUPERLATTICES/kubo formula; EQUATIONS OF MOTION; GREEN FUNCTION; HAMILTONIANS; RENORMALIZATION; SUPERLATTICES; TUNNEL EFFECT

35213 (INIS-BR–1483, pp. 51) **Electronic structure of III-V semiconductors oxides.** Sperco, S.J. (3290680AR); Lannoo, M.; Hollinger, G. Minas Gerais Univ., Belo Horizonte (Brazil). Dept. de Fisica. 1989. (CONF-8901126–: 4. Brazilian school of semiconductor physics, Belo Horizonte, Brazil, 23 Jan - 3 feb 1989). In *Proceedings of the 4. Brazilian School of Semiconductor Physics.* Order Number DE89612194/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

ALUMINIUM PHOSPHATES/arsenic compounds; ALUMINIUM PHOSPHATES/semiconductor materials; GALLIUM PHOSPHATES/arsenic compounds; GALLIUM PHOSPHATES/semiconductor materials; INDIUM PHOSPHIDES/semiconductor materials; INDIUM PHOSPHIDES/sulfur compounds; INDIUM PHOSPHIDES/x radiation; SEMICONDUCTOR MATERIALS/electronic structure; SEMICONDUCTOR MATERIALS/photoemission; HAMILTONIANS; PHOTOEMISSION; VALENCE

35214 (INIS-BR–1483, pp. 54) **Study of the oxygen precipitation on p-type Czochralski silicon.** Bulla, D.A.P. (Sao Paulo Univ., SP (Brazil). Inst. de Fisica); Stojanoff, V. Minas Gerais Univ., Belo Horizonte (Brazil). Dept. de Fisica. 1989. (In Portuguese). (CONF-8901126–: 4. Brazilian school of semiconductor physics, Belo Horizonte, Brazil, 23 Jan - 3 feb 1989). In *Proceedings of the 4. Brazilian School of Semiconductor Physics.* Order Number DE89612194/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

OXYGEN/agglomeration; OXYGEN/point defects; POINT DEFECTS/bragg reflection; POINT DEFECTS/oxygen; POINT DEFECTS/x-ray diffraction; SILICON/czochralski method; SILICON/p-type conductors; SILICON/point defects; BORON; DOPED MATERIALS; HEAT TREATMENTS; HIGH TEMPERATURE; MONOCRYSTALS; OXYGEN; AGGLOMERATION; SILICON

35215 (INIS-BR–1483, pp. 55) **Study of donors in Si-Cz monocrystals.** Castro Junior, W.E. de (Amazonas Univ., Manaus (Brazil). Inst. de Fisica); Stojanoff, V. Minas Gerais Univ., Belo Horizonte (Brazil). Dept. de Fisica. 1989. (In Portuguese). (CONF-8901126–: 4. Brazilian school of semiconductor physics, Belo Horizonte, Brazil, 23 Jan - 3 feb 1989). In *Proceedings of the 4. Brazilian School of Semiconductor Physics.* Order Number DE89612194/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

SILICON/crystal defects; SILICON/x-ray diffraction; ANNEALING; BORON; BRAGG REFLECTION; CZOCHRALSKI METHOD; HIGH TEMPERATURE; MONOCRYSTALS; OXYGEN; PRECIPITATION; SILICON

35216 (INIS-BR–1483, pp. 62) **Electronic structure of ZnS: [Cu,V_{Zn}].** Siqueira, M.L. de (Minas Gerais Univ., Belo Horizonte (Brazil). Dept. de Fisica); Guimaraes, P.S. Minas Gerais Univ., Belo Horizonte (Brazil). Dept. de Fisica. 1989. (CONF-8901126–: 4. Brazilian school of semiconductor physics, Belo Horizonte, Brazil, 23 Jan - 3 feb 1989). In *Proceedings of the 4. Brazilian School of Semiconductor Physics.* Order Number DE89612194/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

SEMICONDUCTOR MATERIALS/crystal defects; SEMICONDUCTOR MATERIALS/multiple scattering; SEMICONDUCTOR MATERIALS/solid clusters; COPPER; EIGENVALUES; ELECTRONIC STRUCTURE; IMPURITIES; ZINC SULFIDES

35217 (INIS-BR–1483, pp. 93) **Absoption model by x-ray diffraction in semiconductors: application to germanium.** Campos, H.S. (Bahia Univ., Salvador (Brazil). Inst. de Fisica); Keller, W.A. Minas Gerais Univ., Belo Horizonte (Brazil). Dept. de Fisica. 1989. (CONF-8901126–: 4. Brazilian school of semiconductor physics, Belo Horizonte, Brazil, 23 Jan - 3 feb 1989). In *Proceedings of the 4. Brazilian School of Semiconductor Physics.* Order Number DE89612194/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

GERMANIUM/semiconductor materials; SEMICONDUCTOR MATERIALS/linear absorption models; SEMICONDUCTOR MATERIALS/x-ray diffraction; GERMANIUM; SELF-CONSISTENT FIELD

35218 (INIS-BR–1483, pp. 47) **Inelastic electron scattering from surface plasmons in a NIPI semiconductor superlattice.** Farias, G.A. (Ceara Univ., Fortaleza (Brazil). Dept. de Fisica); Auto, M.M.; Albuquerque, E.L. de. Minas Gerais Univ., Belo Horizonte (Brazil). Dept. de Fisica. 1989. (CONF-8901126–: 4. Brazilian school of semiconductor physics, Belo Horizonte, Brazil, 23 Jan - 3 feb 1989). In *Proceedings of the 4. Brazilian School of Semiconductor Physics.* Order Number DE89612194/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

INELASTIC SCATTERING/electrons; INELASTIC SCATTERING/superlattices; PLASMONS/superlattices; PLASMONS/surfaces; COLLECTIVE EXCITATIONS; CRYSTAL STRUCTURE; ENERGY LOSSES; ELECTRONS; SUPERLATTICES; PLASMONS; SURFACES; SEMICONDUCTOR MATERIALS

35219 (INIS-BR–1483, pp. 75) **Collective electronic excitations in semiconductor superlattices effects of disorder.** Luz, D.M. (Universidade Federal Fluminense, Niteroi, RJ (Brazil). Inst. de Fisica); D'Albuquerque e Castro, J. Minas Gerais Univ., Belo Horizonte (Brazil). Dept. de Fisica. 1989. (CONF-8901126–: 4. Brazilian school of semiconductor physics, Belo Horizonte, Brazil, 23 Jan - 3 feb 1989). In *Proceedings of the 4. Brazilian School of Semiconductor Physics.* Order Number DE89612194/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

PLASMA WAVES/collective excitations; PLASMA WAVES/superlattices; ELECTRONS; INTERATOMIC DISTANCES; LAYERS; SUPERLATTICES; RANDOM PHASE APPROXIMATION

35220 (INIS-mf–11456, pp. 295-298) **Hyperfine interactions in substituted YIG's.** Englich, J. (Karlova Univ., Prague (Czechoslovakia). Fakulta Matematicko-Fyzikalni); Novak, P. Jednota Ceskoslovenskych Matematiku a Fyziku, Prague (Czechoslovakia). 1987. (In Czech). (CONF-8707217–: 9. conference of Czechoslovak physicists, Pardubice, Czechoslovakia, 6-10 Jul 1987). In *Ninth conference of Czechoslovak physicists. Part 1, 2.* Order Number DE89617602/JAW. Available from NTIS (US Sales Only), PC A22/MF A01 - OSTI; INIS.

The possibilities are studied of the method of nuclear magnetic resonance for the study of magnetic properties and the magnetic structure of ferrimagnetic iron oxides. For measuring NMR spectra the pulse technique was used of the double pulse spin echo. The non-colinear structure was studied of magnetic moments of the rare earth ions in garnets. The NMR was studied of Fe^{3+} ions in polycrystalline samples of $Bi_xY_{3-x}Fe_5O_{12}$ and $La_xY_{3-x}Fe_5O_{12}$. Experimentally confirmed was the anticipated structure of the spectrum. From the temperature dependence of the NMR frequency it is possible to derive the temperature dependence of the magnetic moment of the Fe^{3+} ion. (M.D.). 2 figs., 11 refs.

35221 (INIS-mf–11456, pp. 299-302) **Moessbauer spectroscopy of amorphous magnetic materials.** Zemcik, T. (Ceskoslovenska Akademie Ved, Brno (Czechoslovakia). Ustav Fyzikalni Metalurgie). Jednota Ceskoslovenskych Matematiku a Fyziku, Prague (Czechoslovakia). 1987. (In Czech). (CONF-8707217–: 9. conference of Czechoslovak physicists, Pardubice, Czechoslovakia, 6-10 Jul 1987). In *Ninth conference of Czechoslovak physicists. Part 1, 2.* Order Number DE89617602/JAW. Available from NTIS (US Sales Only), PC A22/MF A01 - OSTI; INIS.

Briefly summed up is available knowledge of the Moessbauer spectroscopy of amorphous ferromagnetic alloys. The main applications consist in obtaining information on the atomic and magnetic structure of the amorphous state, studying the relaxation processes by magnetic changes which they induce and studying the limits of stability of the amorphous state. Examples are given of experiments described in the literature. (M.D.). 2 figs., 10 refs.

35222 (INIS-mf–11456, pp. 277-280) **Microstructure study of amorphous material by EXAFS method.** Smotlacha, O. (Ceskoslovenska Akademie Ved, Prague (Czechoslovakia). Fyzikalni Ustav). Jednota Ceskoslovenskych Matematiku a Fyziku, Prague (Czechoslovakia). 1987. (In Czech). (CONF-8707217–: 9. conference of Czechoslovak physicists, Pardubice, Czechoslovakia, 6-10 Jul 1987). In *Ninth conference of Czechoslovak physicists. Part 1, 2.* Order Number DE89617602/JAW. Available from NTIS (US Sales Only), PC A22/MF A01 - OSTI; INIS.

The X-ray is emitted by the source, passes through monochromator and an intensity monitor, then through the investigated sample and impinges on the detector. During measurement the wavelength of X-radiation gradually changes. Measured is the wavelength dependence of radiation intensity attenuated by the sample. The absorption coefficient shows oscillattions, the so-called fine structure on the shortwave side of the absorption edges. For energies up to 50 eV behind the absorption edge the fine structure is known as XANES (X-ray Absorption Near Edge Structure), for energies between 60 - 80 eV behind the absorption edge it is known as EXAFS (Extended X-ray Absorption Fine Structure). The advantages and disadvantages of the diffraction method and the EXAFS method are

compared on the nonoriented system of two elements. (M.D.). 4 figs., 5 refs.

35223 (IPNO-DRE–87-33(1)) **Spontaneous desorption and plasma desorption mass spectrometry: a simple way to compare keV and MeV ion induced desorption.** Della-Negra, S.; Deprun, C.; Le Beyec, Y.; Bolbach, G. Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire. 1987. 1-2p. (CONF-8705114– : 35. conference on mass spectrometry and applied topics, Denver, Colorado, USA, 24-29 May 1987). Order Number DE89781421/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

Spontaneous and simultaneous emission of negative ions and electrons in a time of flight mass spectrometer was used to compare keV and MeV ion induced desorption. Results obtained with composite films of Cd arachidate layers superposed by monolayers of Cd stereate show that the molecular ion yield of the top layer (stearic acid) increases with the number of layers of the same compound in the Cf252 mode, but decreases strongly in the SD mode. A strong difference betwen Cf252 and SD is also observed in the molecular ion yield of arachidic acid. Mass spectra for two targets consisting of 2 ML of CD stereate on 2 ML of Cd arachidate and on 12 ML of Cd arachidate are shown. They suggest that there are more in flight fragmentations in fission fragment induced desorption than in keV ion induced desorption. It is assumed that more internal energy is on the average transferred to the molecular ions when they are emitted from the layers bombarded by MeV ions.

35224 (IPNO-DRE–87-33(2)) **Thickness and volume effects in MeV ion induced desorption (PDMS).** Della-Negra, S.; Deprun, C.; Le Beyec, Y.; Standing, K.G.; Bolbach, G. Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire. 1987. 3-4p. (CONF-8705114–: 35. conference on mass spectrometry and applied topics, Denver, Colorado, USA, 24-29 May 1987). Order Number DE89781422/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

The origin of ion emission in MeV ion induced desorption was investigated using Cd stearate and arachidate molecules to prepare targets. Experiments were performed with fission fragments from a Cf252 source and 1.16 MeV/u Kr ions accelerated by a linear accelerator. The variation of the ion yield from composite films as a function of the Langmuir-Blodgett film thickness of the same molecule, as well as the decrease of the yield for ions from subsurface layers are compatible with an emission from a conical volume of 200Å depth.

35225 (IPNO-DRE–87-33(5)) **Secondary ion emission from surface and volume with high and low energy ions.** Deprun, C.; Della-Negra, S.; Le Beyec, Y.; Bolbach, G. Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire. 1987. 13p. (In French). (CONF-8709414–: 6. mass spectrometry colloquium, Strasbourg, France, 15-17 Sep 1987). Order Number DE89781427/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Secondary ion emission from fast ion impact (Cf252 fission fragments) of Langmuir-Blodgett films consisting of superposed two molecule layers with similar structure and mass (Cd stereate and Cd arachidate) was analyzed. Emission of deproton secondary ions of stereate and arachidate acids was studied for various target configurations. Results show that under the influence of high energy ions, secondary ion ejection comes from a conical volume of 200A depth.

35226 (IPNO-DRE–87-33(6)) **Fast ion desorption (Mev/u): interaction depth in secondary H+ ion emission: probe of the surface-projectile interaction.** Della-Negra, S.; Le Beyec, Y.; Monart, B.; Standing, K.; Wien, K. Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire. 1987. 14p. (In French). (CONF-8709414–: 6. mass spectrometry colloquium, Strasbourg, France, 15-17 Sep 1987). Order Number DE89781425/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The emission of ions resulting from the bombardment of solid targets by 1 MeV/u projectiles was studied by time of flight spectrometry to examine the energy transfer process from the interior of a material towards the surface. Results show an interaction depth between the primary ion and the material which varies according to the type of secondary ion emitted. The depth calculated using a model is 200 A for agregates emitted from a CsI target bombarded by a Kr 18^+ beam. The estimates were verified using an H^+ probe.

35227 (JINR–14-88-535) **Influence of ionization and heavy ion nuclear energy losses on defect formation in LiF crystals.** Didyk, A.Yu.; Oganesyan, R.Ts.; Skuratov, V.A.; Regel', V.R. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions. 1988. 10p. (In Russian). Order Number DE89618626/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Submitted to Fiz. Tverd. Tela.

Absorption spectra and mechanical properties of LiF irradiated with ^{136}Xe (118 MeV), Ar (225,46,3 MeV), ^{20}Ne (112,5 MeV), ^{22}Ne (26,9 MeV) ions at 10^{10}-10^{14} cm^{-2} dose range were studied. It determined by total ionization energy losses of heavy ions. The observed differences in dose dependences of point defect concentrations for Xe, Ar, Ne beginning after certain dose may be explained as a result of ion track overlapping. The change of mechanical properties of LiF is determined by the radiation damages caused by elastic collisions of bombarded ions with lattice atoms. 12 refs.; 5 figs.; 1 tab.

35228 (JINR-E–14-88-429) **Neutron scattering investigations of lattice dynamics and structure of superconducting ceramics $La_{2-x}Sr_xCuO_{4-\delta}$ at different temperatures.** Belushkin, A.V.; Goremychkin, E.A.; Natkaniec, I. and others. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics. 1988. 10p. Order Number DE89618553/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Submitted to the journal Phys. C.

Inelastic neutron scattering (INS) together with neutron diffraction (simultaneous information on the structure behaviour) were measured for $La_{2-x}Sr_xCuO_{4-\delta}$ (x=0.0, 0.1, 0.2, 0.3) at temperatures: 290, 77 and 10 K using - the time-of-flight spectrometer at the pulsed reactor. A new line near the energy transfer of 6 MeV has been detected in the INS spectra at 77 and 10 K. The intensity of this line depends on both momentum transfer and temperature. That points to the magnetic nature of the corresponding excitation. It also veries with strontium concentration. 17 refs.; 3 figs.; 1 tab.

35229 (JINR-E–14-88-430) **Phonon density of states of $YBa_2Cu_3O_x$ in dependence on oxygen content and temperature.** Natkaniec, I.; Belushkin, A.V.; Mayer, J. and others. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics. 1988. 6p. Order Number DE89618554/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Submitted to the journal Pis'ma Zh. Ehksp. Teor. Fiz.

Inelastic neutron scattering (INS) and neutron diffraction spectra of $YBa_2Cu_3O_x$ compounds for x=6.95, 6.45 and 6.15 at temperatures 290, 80 and 10 K were measured. Generalized functions of phonon density of states (GDOS) obtained from INS spectra change significantly in the wide energy range from 10 to 90 MeV with increasing oxygen deficiency. An anomalous increase of the GDOS at energies from 15 to 40 MeV with decreasing temperature was observed for superconducting samples (x=6.15 and 6.45), while in the non-superconducting sample (x=6.15) such effect was less pronounced. 20 refs.; 2 figs.; 1 tab.

35230 (JINR-R–4-88-447) **On determination of the magnetic field penetration depth in oxide superconductors by polarized neutron reflection.** Korneev, D.A.; Chernenko, L.P. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics. 1988. 11p. (In Russian). Order Number DE89618555/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Submitted to Poverkhn: Fiz., Khim., Mekh.

The $R_+(k_{perpendicular})$ reflection coefficients are calculated for $YBa_2Cu_3O_7$ film sprayed from $SrTiO_3$ ($k_{perpendicular}$ is a normal to the surface componenta of a wavevector of neutrons) using the qiantum mechanical model describing the reflection of neutrons from the surface of a thin superconducting film. The dependence of $S(k_{perpendicular})=R_{(sub)}(k_{perpendicular})/R_+(k_{perpendicular})$ on the depth of magnetic field penetration into a superconductor Λ, on the external magnetic field H, and on a film thickness d is analysed. The possibility is motivated of carrying out experiments on determination of Λ under condition compared favourably with those under which the experiments with massive samples of high temperature superconductor have been conducted. 7 refs.; 6 figs.; 1 tab.

35231 (LA-UR–89-1486) **Partial pressure analysis of CF_4/O_2 plasmas.** Martz, J.C.; Hess, D.W.; Anderson, W.E. Los Alamos National Lab., NM (USA). 1989. 5p. Sponsored by DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-8809125–2: NATO ASI on plasma surface interaction and processing of materials, Alicante, Spain, 4-16 Sep 1988). Order Number DE89012654/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This work will examine a simple down-stream sampling arrangement for effluent analysis in a typical plasma environment. This method offers the advantage of simplicity when compared to the need for extraction optics and energy analyzing stages required for flux-type analysis. In addition, partial pressure analysis provides information on the plasma/surface interactions occurring over the entire surface area of the reactor as opposed to just those occurring at the sampling orifice in flux-type analysis. This fact makes partial-pressure analysis particularly attractive for such tasks as plasma-etch end-point monitoring. In this example, experimental partial-pressure measurements of a CF_4/O_2 plasma are presented as is the application of the technique to plasma etch end-point detection. 12 refs., 2 figs.

35232 (LYCEN–87-48) **Charge exchange processes of foil dissociation fragments of fast H^+_2 ions and H^+_n clusters.** Mazuy, B.; Belkacem, A.; Chevallier, M.; Gaillard, M.J.; Poizat, J.C.; Remillieux, J. Lyon-1 Univ., 69 - Villeurbanne (France). Inst. de Physique Nucleaire. Oct 1987. 10p. (CONF-8710159–: 12. international conference on atomic collisions in solids, Okayama, Japan, 12-16 Oct 1987). Order Number DE89781496/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

We have measured angular and charge state distributions of atomic fragments resulting from the foil dissociation of 30-120 KeV/p H^+_n clusters. The fragment neutralization probability has been investigated for beam velocities above and around the Bohr velocity. At a given velocity the width of the angular distribution of neutral atoms and their yield are observed to increase with n up to $n > 5$ and $n > 7$, respectively. Moreover we have used the simpler H^+_2 case to propose new ideas to explain the vicinity effects observed on the charge exchange processes.

35233 Charge-exchange cross sections for 445-MeV Cl ions in solid C targets. Sofield, C. J. (Nuclear Physics Division, Atomic Energy Research Establishment, Harwell, United Kingdom Atomic Energy Authority Didcot, Oxfordshire 0X11 ORA, United Kingdom(GB)); Bridwell, L. B.; Moak, C. D.; Miller, P. D.; Gregory, D. C.; Jones, C. M.; Al *Physical Review [Section] A: General Physics (USA),* 40(1): 59-68 (1 Jul 1989).

CHLORINE IONS/ion spectroscopy; CARBON/charged-particle transport; CARBON; ELECTRON LOSS; EXCITATION; ELECTRON CAPTURE; CHARGE STATES; EQUILIBRIUM; CROSS SECTIONS; MEV RANGE 100-1000; EXPERIMENTAL DATA

35234 Evaluation of geometrical contributions to the spread of the Compton-scatter energy distribution. Hanson, A. L. (Brookhaven National Laboratory, Upton, New York 11973(US)); Gigante, G. E. *Physical Review [Section] A: General Physics (USA),* 40(1): 171-180 (1 Jul 1989). DOE Contract AC02-76CH00016.

The spectrum from Compton-scattered x rays is an inherently broaddistribution. This distribution is the sum of several Gaussian-likedistributions, which gives the sum its unique shape. The Gaussian-likedistributions are the result of convoluting the so-called Compton profile, thespread in the scattered-x-ray energies due to the momentum distributions of thetarget electrons, with the detector response and the geometrical effects. Thedistribution is then further modified by the absorption within the sample. Aformulation for both qualitatively and quantitatively determining the magnitudeof the geometrical contributions is presented. This formulation is based on arecently devised approach to the scattering geometry [Hanson, Gigante, Meron,Phys. Rev. Lett. 61, 135 (1988)]. A methodology for determiningthe geometrical spread in the energy of the scattered x rays is presented. Theresults can be conveniently used to optimize scattering geometries for thereduction of the geometry-caused spread.

35235 Steady-state propagation of a crack in a viscoelastic strip. Barber, M. (Institute for Theoretical Physics, University of California, Santa Barbara, California 93106(US)); Donley, J.; Langer, J. S. *Physical Review [Section] A: General Physics (USA),* 40(1): 366-376 (1 Jul 1989).

The theory of steady-state propagation of a crack in a viscoelastic solidis reexamined in light of recent developments in ostensibly similarfree-boundary problems, specifically, dendritic crystal growth and viscousfingering. We find that, at least within the conventional formulation offracture dynamics, the problem of predicting the growth rate and the shape of acrack does not involve mathematical subtleties analogous to those which havebeen found in the previously mentioned situations. We derive some generalformulas for the variation of the shape of the cohesive zone at the crack tipas a function of driving force, and we compute specific shapes, growth rates,and dissipation patterns for a simple model of the cohesive stresses.

35236 Dynamic polarization of ^{19}F in a fluorinated alcohol. Hill, D. (Argonne National Lab., IL (USA)); Kasprzyk, T.; Jarmer, J.J.; Penttilae, S.; Krumpolc, M.; Hoffmann, G.W.; Purcell, M. *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment (Netherlands),* 277(2/3): 319-322 (1 May 1989). DOE Contract W-31-109-ENG-38;AS05-80ER10638.

We studied microwave dynamic cooling of ^{19}F and ^1H nuclei in mixtures of 1,1,1,3,3,3-hexafluoro-2-propanol and water, doped with Cr(V) complex. Equal spin temperatures of the two nuclei are produced, and the highest spin polarizations ($\simeq$ 80%) are found in mixtures near the eutectic ratio. The high fluorine content and polarization make this a suitable target material for polarized nuclear scattering experiments.

35237 Charge-exchange reactions in metal clusters: Role of magic numbers. Khanna, S. N. (Department of Physics, Virginia Commonwealth University, Richmond, Virginia 23284-2000(US)); Jena, P.; Rao, B. K. *Physical Review [Section] B: Condensed Matter (USA),* 40(2): 966-969 (15 Jul 1989).

Using total energies calculated from self-consistent theories, we show thatthe charge-exchange reactions of metal clusters tend to favor the production of"magic-number" species in larger clusters. Implications of our results forone's ability to produce neutral-cluster beams of a given size are discussed.

35238 Calibration of an argon in germanium standard using Rutherford backscattering spectrometry for energy dispersive x-ray spectroscopy. Skulina, K. M. (Department of Nuclear Engineering, Phoenix Memorial Laboratory, The University of Michigan, Ann Arbor, Michigan 48109-2100(US)); van der Leeden, G. A.; Vincent, D. H. *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films (USA),* 7(4): 2794-2796 (Jul 1989).

An argon standard for energy dispersive x-ray spectroscopy (EDS) has been made by bias sputtering hydrogenated amorphous germanium (*a*-Ge:H) films and determining the concentration of argon with Rutherford backscattering spectrometry. Varying concentrations of argon in hydrogenated amorphous germanium were achieved by changing the dc bias on the substrate holder and the gas pressure during rf magnetron sputtering onto a silicon substrate. It was found that standardless EDS analysis underestimates the argon concentration by about a factor of 2.

35239 Structural and dynamical consequences of interactions in interfacial systems. Landman, U. (School of Physics, Georgia Institute of Technology, Atlanta, Georgia 30332(US)); Luedtke, W. D.; Ribarsky, M. W. *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films (USA),* 7(4): 2829-2839 (Jul 1989).

Basic understanding of the structure and dynamics of materials and their response to external perturbations requires knowledge on the microscopic level, of the underlying energetics and atomic dynamics, whose consequences we observe and measure. Coupled with the above is the everlasting quest to observe and understand natural phenomena on refined microscopic scales, which provides the impetus for the development of experimental and theoretical techniques for the interrogation of materials with refined spatial and temporal resolution. In this paper we review molecular dynamics simulations for studies of the energetics and dynamical response of

materials to external mechanical perturbations. Applications to investigations of solid and liquid interfacial systems under stress and to studies of the consequences of tip–substrate interactions in atomic force microscopy are demonstrated.

35240 **Simple and efficient procedure for the Monte Carlo calculation of the surface free energy in coexisting phases.** Potvin, J. (Department of Physics, Boston University, Boston, Massachusetts 02215(CA)); Rebbi, C. *Physical Review Letters (USA)*, 62(26): 3062-3065 (26 Jun 1989).

We describe a new method for calculating the surface tension along a surface separating two coexisting phases. It is based on a Monte Carlo simulation where one-half of the lattice is adiabatically brought from one phase to the other. The surface free energy is obtained as a difference between the total free energies of the homogeneous and mixed phases. We present the results from a numerical simulation of the two-dimensional seven-state Potts model. Application to lattice quantum chromodynamics is also discussed.

6561 Superconductivity

Refer also to citation(s) 33890, 33968, 33969, 33972, 33974, 33975, 34127, 34305

35241 (IC–88/339) **Time dependence of magnetization of high temperature superconductors.** Larkin, A.I.; Geshkenbein, V.B. International Centre for Theoretical Physics, Trieste (Italy). Oct 1988. 9p. Order Number DE89617777/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Magnetization of high T_c superconductors logarithmically decreases with time. There is a maximum in the temperature dependence of the coefficient at this logarithm. If one assumes that there do exist two kinds of pinning centers, then this dependence can be described in the Anderson theory of thermal creeps of Abrikosov's vortices. The temperature dependence of the critical current is also discussed. (author). 23 refs.

35242 (IC–88/340) **Mott transition: Low-energy excitations and superconductivity.** Ioffe, L.B.; Larkin, A.I. International Centre for Theoretical Physics, Trieste (Italy). Sep 1988. 17p. Order Number DE89617778/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

It is possible that metal-dielectric transition does not result in changes of magnetic or crystallographic symmetry. In this case a fermionic spectrum is not changed at the transition, but additional low-energy excitations appear which can be described as a gauge field that has the same symmetry as an electromagnetic one. In the case of a non half-filled band gapless scalar Bose excitations also appear. Due to the presence of additional gauge field the physical conductivity is determined by the lowest conductivity of the Fermi or Bose subsystems. (author). 11 refs.

35243 (IC–88/366) **Off-diagonal long-range order and superconducting particle density.** Pang Gendi; Pu Fucho; Zhao Baoheng. International Centre for Theoretical Physics, Trieste (Italy). Dec 1988. 12p. Order Number DE89617779/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Relations between the existence of ODLRO in the reduced density matrix rho_n (for all $n \geq 1$) and that of superconducting currents in a hollow cylinder is discussed. Some concrete behaviours of rho_n, including the power lay decaying behaviour, in the coordinate space representation are considered and the corresponding effective superconducting particle densities are given. Some restraint conditions caused by the existence of the ODLRO (including quasi-ODLRO) have been found and discussions on the minimum unit of flux quantization are also included. (author). 3 refs.

35244 (IC–88/427) **Composite VS constituent particle aspects of hole motion in the CuO_2 plane.** Su Zhaobin; Yu Lu. International Centre for Theoretical Physics, Trieste (Italy). Dec 1988. 11p. Order Number DE89618864/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The question whether the basic physics related to Hi-Tc Superconductivity can be described in terms of the one-band Hubbard model, or an oxygen-copper two-band model, is a question under active discussion. In this paper, a theoretical scheme is developed to consider the oxygen-copper singlet state as a composite particle. It appears as a bound state in low-frequency phenomena such as conductivity and IR absorption. On the contrary, the oxygen and copper states appear as constituent particles in high-frequency phenomena such as high-energy electron spectroscopy. Depending on the values of the parameters involved, a two-band Fermi-liquid type behavior, or an one-band Hubbard type behavior, should be expected. On the one band, a p-wave pairing of holes induced by antiferromagnetic spin fluctuations, is discussed in the Fermi-liquid picture. On the other hand, the oxygen propagation effect, the renormalization of the hole hopping integral, as well as the possible interpretation of the conductivity, are considered in the composite particle picture. A possible scenario for superconductivity, differing both from the BCS pairing and the holon condensation, is speculated. (author). 25 refs, 1 fig.

35245 (IC–89/11) **Pinning of curved flux lines on the boundary between two phases of high temperature superconductors.** Saif, A.G. International Centre for Theoretical Physics, Trieste (Italy). Jan 1989. 11p. Order Number DE89618865/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The distribution of the magnetic fields and the current density in a system of two phases of high temperature superconductors (HTS) are determined. Recently, this system has been confirmed experimentally. The energy of the interaction between curved flux lines (FLs) and the interface is calculated. It is shown that for positive ΔG (the change in the flux line (FL) energy at the Interface) the FLs will be pinned by the interface and the pinning force is formulated. Moreover, this force will be different according to the movement of the FL to the right or to the left. Agreements with the previous results (in special cases) are obtained. This study may serve to test the pinning experimentally. (author). 4 refs.

35246 (LBL–26578) **Bibliography of high-T_c superconducting films.** Talvacchio, J. Lawrence Berkeley Lab., CA (USA); Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center. Jan 1989. 60p. Sponsored by DOE Energy Research. DOE Contract AC03-76SF00098. Order Number DE89013395/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

This document represents an effort to make bibliographic information on high-T_c superconductor films available to those who cannot access the on-line database at the Westinghouse R and D Center. The database contains a growing list of references – approaching 5000 – each of which is identified by a set of two-letter keywords. The database is used the same way as as INSPEC's, but its fixed set of standard keywords enables the user to obtain a complete list of references on keyworded topics. Since a single keyword (or search term) such as "sputtering" creates a bibliography that is too long for practical use, the database is used most effectively by combining a series of keywords using Boolean algebra to identify a handful of relevant references. The structure of this document is intended to present the subset of papers concerning high-T_c films (725 papers) in a compact format as a substitute for on-line searches. Rather than listing separate bibliographies for each of the 185 keywords, a single list of all the references is contained in Section 6, and indices based on the keywords are contained in Sections 3–5. This report is a true bibliography and does not contain any informative text. 725 refs.

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Refer also to citation(s) 34961, 35154

35247 (AECL–8482) **Solution to the driven diffusion of a step boundary with a source term.** Zee, R.H.; Lee-Whiting, G.E. Atomic Energy of Canada Ltd., Chalk River, ON (Canada). Chalk River Nuclear Labs. Jun 1984. 19p. Order Number DE89618391/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The partial differential equation governing the one-dimensional driven diffusion of a step boundary is solved analytically using the Laplace transform technique for a finite system and an infinite system both with either a constant source or a concentration-proportional source. The analytical solutions for the two finite

systems each includes an infinite series which becomes negligible at long times. The solutions for the two infinite systems are in the form of error functions. Effects of the source term on the eletrotransport of oxygen in zirconium are examined.

35248 (CBPF-NF–063/88) **General exact solution for homogeneous time-dependent self-gravitating perfect fluids.** Gaete, P.; Hojman, R. Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro, RJ (Brazil). 1988. 17p. Order Number DE89618425/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A procedure to obtain the general exact solution of Einstein equations for a self-gravitating spherically-symmetric static perfect fluid obeying an arbitrary equation of state, is applied to time-dependent Kantowsky-Sachs line elements (with spherical, planar and hyperbolic symmetry). As in the static case, the solution is generated by an arbitrary function of the independent variable and its first derivative. To illustrate the results, the whole family of (plane-symmetric) solutions with a "gamma-law" equation of state is explicity obtained in terms of simple known functions. It is also shown that, while in the static plane-symmtric line elements, every metric is in one to one correspondence with a "partner-metric" (both originated from the same generatrix function), in this case every generatrix function univocally determines one metric.

35249 (IC–88/293) **Left regular bands of groups of left quotients.** El-Qallali, A. International Centre for Theoretical Physics, Trieste (Italy). Oct 1988. 17p. Order Number DE89618376/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A semigroup S which has a left regular band of groups as a semigroup of left quotients is shown to be the semigroup which is a left regular band of right reversible cancellative semigroups. An alternative characterization is provided by using spinned products. These results are applied to the case where S is a superabundant whose set of idempotents forms a left normal band. (author). 13 refs.

35250 (IC–88/329) **Structure of the fixed point set of an involutory automorphism of PSL(2,q), q odd, $q \geq 5$.** Hassani, A. International Centre for Theoretical Physics, Trieste (Italy). Nov 1988. 12p. Order Number DE89617522/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

PSL(2,q) is the projective special linear group. The automorphism group of PSL(2,q) is denoted by $P\Gamma L(2,q)$. The structure of $P\Gamma L(2,q)$ is well-known, it is isomorphic to the semidirect product of PGL(2,q) by a cyclic group A of order n, where $q=p^n$, p a prime. Taking α is an element of $P\Gamma L(2,q)$ such that $\alpha^2=1$ by considering conjugacy classes of involutions in $P\Gamma L(2,q)$ and finding the centralizer of this element in PSL(2,q) we prove the following result. Theorem: Let α be an involutary automorphism of PSL(2,q) where q is odd and $q \geq 5$. Then (i) if q is not a square the fixed point set of α is either dihedral of order q-1 or dihedral of order q+1. (ii) If $q=r^2$ the fixed point set of α is either dihedral of order q-1, or dihedral of order q+1 or is isomorphic to PGL(2,r). (author). 2 refs.

35251 (IC–88/353) **Generation of higher-order squeezing of quantum electromagnetic fields by degenerate four-wave mixing and other processes.** Li Xizeng; Shan Ying; Mandel, L. International Centre for Theoretical Physics, Trieste (Italy). Nov 1988. 7p. Order Number DE89618392/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

It is found that the field of the combined mode of the probe wave and the phase-conjugate wave in the process of degenerate four-wave mixing exhibits higher-order squeezing to all even order. The degree of squeezing increases with the order N, and the higher-order squeeze parameter q_N may approach -1. (author). 3 refs, 2 figs.

35252 (IC–88/383) **On the areas of various bodies in the Euclidean space: The case of irregular convex polygons.** Ozoemena, P.C. International Centre for Theoretical Physics, Trieste (Italy). Nov 1988. 20p. Order Number DE89618377/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A theorem is proposed for the areas of n-sided irregular convex polygons, of given length of sides. The theorem is illustrated as a simple but powerful one in estimating the areas of irregular polygons, being dependent only on the number of sides n (and not on any of the explicit angles) of the irregular polygon. Finally, because of the global symmetry shown by equilateral triangles, squares and circles under group (gauge) theory, the relationships governing their areas, when they are inscribed or escribed in one another are discussed as riders, and some areas of their applications in graph theory, ratios and maxima and minima problems of differential calculus briefly mentioned. (author). 11 refs, 6 figs, 1 tab.

35253 (IC–88/385) **Chaoticity of interval self-maps with positive entropy.** Xiong Jincheng. International Centre for Theoretical Physics, Trieste (Italy). Dec 1988. 12p. Order Number DE89618378/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Li and Yorke originally introduced the notion of chaos for continuous self-map of the interval I = (0,1). In the present paper we show that an interval self-map with positive topological entropy has a chaoticity more complicated than the chaoticity in the sense of Li and Yorke. The main result is that if f:I -> I is continuous and has a periodic point with odd period > 1 then there exists a closed subset K of I invariant with respect to f such that the periodic points are dense in K, the periods of periodic points in K form an infinite set and f—K is topologically mixing. (author). 9 refs.

35254 (IC–88/403) **Finding isolated zero points of complex polynomial mappings.** Xu Senlin. International Centre for Theoretical Physics, Trieste (Italy). Dec 1988. 16p. Order Number DE89617523/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

In this paper, at first the properties of isolated zero points of complex polynomial mappings are discussed using the integral expression of a degree of C^1 mapping, Sard's Theorems and homotopy. Then we prove that for almost every complex polynomial mapping $P:C^n->C^n$, the zero set $H^{-1}(0)$ of the homotopy $H(z,t)=tP(z)+(1-t)Q(z)$ consists of $s=P|_{j=1}{}^n s_j$ disjoint differential curves, and the zero set $phi_{\delta(subj)}{}^{-1}(0)$ of its piecewise linear approximation $phi_{\delta(subj)}$ consists of some broken lines which do not meet ν-dimensional simplexes ($0 \leq \nu \leq 2n-1$), where $Q(z)=(Q_1(z),...,Q_n(z))$, $Q_j(z)=z_j{}^{aj}-b_j{}^{aj}$, $b_j$not $=0, j=1,...,n$. When ($\lim_{j->\infty} \delta_j=0$), these broken lines tend to corresponding differential curves in $H^{-1}(0)$. (author). 4 refs.

35255 (IC–88/404) **S^7 without any construction of Lie group.** Zhou Jian; Xu Senlin. International Centre for Theoretical Physics, Trieste (Italy). Dec 1988. 7p. Order Number DE89618380/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

It was proved that the sphere S^n is a parallelizable manifold if and only if n = 1,3 or 7, and that S^n is an H-space if and only if n = 0,1,3 or 7. Because a Lie group must necessarily be a parallelizable manifold and also an H-space, naturally one asks that S^n is a Lie group for n = 0, 1,3 or 7? In this paper we prove that S^7 is not a Lie group, and it is not even a topological group. Therefore, S^n is a Lie group (or a topological group) if and only if n = 0,1,3. (author). 11 refs.

35256 (IC–88/409) **$S^m(1)$ x $S^{n-m}(1)$ is embedded into $S^{n+1}(1)$ with prescribed mean curvature.** Huang Xuanguo. International Centre for Theoretical Physics, Trieste (Italy). Nov 1988. 10p. Order Number DE89617524/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

It is proved that $S^m(1)$ x $S^{n-m}(1)$ can be imbedded into $S^{n+1}(1)$ with suitable mean curvature function. (author). 3 refs.

35257 (IC–88/410) **Compact surface in three-dimensional ellipsoid with prescribed mean curvature (I).** Huang Xuanguo. International Centre for Theoretical Physics, Trieste (Italy). Dec 1988. 10p. Order Number DE89618381/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

It is proved that torus $S^1(1)xS^1(1)$ can be embedded into three-dimensional ellipsoid M_3 with suitable mean curvature function. (author). 3 refs.

35258 (IC–88/416) **Spherically symmetric solutions in dimensionally reduced spacetimes.** Mignemi, S.; Wiltshire, D.L. International Centre for Theoretical Physics, Trieste (Italy). Dec 1988. 24p. Order Number DE89617529/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

We study static solutions of the vacuum Einstein equations in D=m+n+2 dimensions which have the following symmetries; the solutions are spherically symmetric in (m+2) dimensions, (or more generally the m-sphere is replaced by any arbitrary m-dimensional Einstein space), while the internal space is an arbitrary n-dimensional Einstein space. The global properties of all such solutions are derived by considering the equivalent dimensionally reduced system in (m+2) dimensions, and by using techniques from the theory of dynamical systems after a judicious choice of variables. Apart from the trivial case of the Schwarzschild solution with constant scalar field all solutions are found to contain naked singularities or else not to be asymptotically flat; as would be expected from the "no hair" theorems. (author). 27 refs, 2 figs.

35259 (IC–88/417) **Reductions and quantization.** Mladenov, I.M. International Centre for Theoretical Physics, Trieste (Italy). Dec 1988. 14p. Order Number DE89618393/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The interchangeability of the Marsden-Weinstein reduction procedure and the Kostant-Souriau geometric quantization is studied by detailed examination of a concrete dynamical system - the so called MIC-Kepler problem. It is proved that some stages of reduction plus geometric quantization technique produce the complete quantum spectrum of the system while others give part of it or nothing. (author). 30 refs.

35260 (IC–88/419) **Extended Weyl group for Kac-Moody algebras.** Dobrev, V.K. International Centre for Theoretical Physics, Trieste (Italy). Dec 1988. 15p. Order Number DE89617525/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

We introduce an extended Weyl group W^e for the highest weight modules over $A_1^{(1)}$. This group is the direct product of the standard affine Weyl (or Weyl-Kac) group W and a new group W_a. The latter we introduced recently in order to rewrite the character formulae for certain factor modules of singular Verma modules (i.e., Verma modules for which the central charge is equal to minus the dual Coxeter number) in the form of the classical Weyl character formula for the finite-dimensional irreducible representations of semisimple Lie algebras (resp. Weyl-Kac character formula for the integrable highest weight modules over affine Kac-Moody algebras) so that W_a was playing the role of the usual Weyl group (resp. affine Weyl group). We use the extended group W^e to rewrite in a similar manner the characters of factor modules of a larger class of Verma modules including also all Verma modules with integral highest weights. Thus our new formula includes as partial cases the Weyl-Kac character formula and the character formulae obtained. We make also the conjecture that our formula holds for any affine Kac-Moody algebra. (author). 15 refs.

35261 (IC–88/420) **On sufficient conditions for a function to be analytic.** Diab, F.M. International Centre for Theoretical Physics, Trieste (Italy). Dec 1988. 8p. Order Number DE89618382/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

The object of this note is to discuss the minimal requirements for monogeneity (and in particular, for analyticity) of schlicht continuous mappings in the sense that the slightest alteration in these requirements endangers the possibly analytical character of such mappings. (author). 6 refs.

35262 (IC–88/428) **General hulls in uniform algebras.** Tonev, T.V. International Centre for Theoretical Physics, Trieste (Italy). Dec 1988. 10p. Order Number DE89618383/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Here we give an approach for introducing general hulls of closed subsets of the spectrum of a given uniform algebra, that relates to n-th Shilov-Sibony-Basener boundaries. 9 refs.

35263 (IC–88/429) **Analytic manifolds in uniform algebras.** Tonev, T.V. International Centre for Theoretical Physics, Trieste (Italy). Dec 1988. 8p. Order Number DE89618384/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Here we extend Bear-Hile's result concerning the version of famous Bishop's theorem for one-dimensional analytic structures in two directions: for n-dimensional complex analytic manifolds, n>1, and for generalized analytic manifolds. 14 refs.

35264 (IC–88/430) **Higher-dimensional black holes with realistic asymptotes in the presence of dilatons and electromagnetic fields.** Ivanov, B.I. International Centre for Theoretical Physics, Trieste (Italy). Dec 1988. 29p. Order Number DE89618426/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

We find black hole solutions in higher dimensions with extra space in orthogonal coordinates, which compactifies at infinity. We study the effect of massless scalar fields, abelian electromagnetic fields and their interacting combination advocated by the heterotic string theory. The conditions under which the extra space blows up near the horizon are given. (author). 9 refs.

35265 (IC–89/1) **Multiple pole solutions of the AKNS hierarchy and its reductions.** Gu Xinshen. International Centre for Theoretical Physics, Trieste (Italy). Jan 1989. 7p. Order Number DE89618385/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

By using the universal formulas of multiple pole solutions for AKNS hierarchy, the universal formulas of multiple pole solutions for three reductions of AKNS hierarchy, which include M-kdV hierarchy and NLS hierarchy, are obtained. (author). 6 refs.

35266 (IC–89/3) **Black holes and the heterotic string.** Ivanov, B.V. International Centre for Theoretical Physics, Trieste (Italy). Jan 1989. 11p. Order Number DE89618427/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

We find explicitly and classify some of the black hole solutions for the effective Lagrangian induced by the heterotic string in the tree approximation. (author). 5 refs.

35267 (IC–89/4) **Kasner-type black holes.** Ivanov, B.V. International Centre for Theoretical Physics, Trieste (Italy). Jan 1989. 14p. Order Number DE89618428/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A joint study is standard and isotropic coordinates allows to give a complete classification of higher-dimensional black holes with string-inspired boundary conditions. Except the typical case with a horizon and a singularity inside, we find black holes with finite metric and flat-time solutions with non-trivial space properties. The constraints on the free parameters are analogous to the constraints for Kasner cosmological solutions. (author). 7 refs.

35268 (IC–89/6) **D=3 Chern-Simons action, supergravity and quantization.** Dayi, O.F. International Centre for Theoretical Physics, Trieste (Italy). Jan 1989. 12p. Order Number DE89617530/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

An interpretation of three-dimensional simple supergravity as a pure Chern-Simons gauge action is shown to be valid up to the one loop level. Canonical quantization of this system does not lead to an explicit definition of the physical Hilbert space. Hence another formulation of the N = 1 three-dimensional supergravity is introduced. In this formalism an explicit definition of the physical Hilbert space is possible, but still one has to solve the problems of showing that there exists a global set of coordinates and of defining the inner product. (author). 10 refs.

35269 (IC–89/10) **On the hydrodynamic approach to the Schroedinger equation.** Zanette, D.H. International Centre for Theoretical Physics, Trieste (Italy). Jan 1989. 5p. Order Number DE89618394/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

The classical limit of the Schroedinger equation is analyzed in the frame of its hydrodynamical formulation. In that limit the probability density develops shock waves, clearly contradicting the exact result. By an approximated analysis in the point on which these discontinuities appear, it is shown that their formation is inhibited by quantum effects. (author). 4 refs.

35270 (IC–89/12) **Inverse scattering transform method and soliton solutions for Davey-Stewartson II equation.** Arkadiev, V.A.; Pogrebkov, A.K.; Polivanov, M.C. International Centre for Theoretical Physics, Trieste (Italy). Jan 1989. 15p. Order Number DE89618395/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The inverse scattering method for Davey-Stewartson II (DS-II) equation including both soliton and continuous spectrum solutions is developed. The explicit formulae for N-soliton solutions are given. Note that our solitons decrease as $-z-^{-2}$ with z tending to infinity. (author). 8 refs.

35271 (IC–89/13) **Compact hypersurface in n+1 dimensional ellipsoid with prescribed mean curvature.** Huang Xuanguo. International Centre for Theoretical Physics, Trieste (Italy). Feb 1989. 11p. Order Number DE89618386/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

It is proved that n dimensional unit sphere $S^n(1)$ can be imbedded into a n+1 dimensional ellipsoid with suitable mean curvature function. (author). 6 refs.

35272 (IC–89/22) **Compact surface in three-dimensional ellipsoid with prescribed mean curvature (II).** Huang Xuanguo. International Centre for Theoretical Physics, Trieste (Italy). Feb 1989. 24p. Order Number DE89618387/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

It is proved that 2-dimensional Ellipsoid can be imbedded into a 3-dimensional Ellipsoid with suitable mean curvature function. (author). 3 refs.

35273 (IC–89/44) **Markov processes in Hilbert space and continuous spontaneous localization of systems of identical particles.** Ghirardi, G.C.; Pearle, P.; Rimini, A. International Centre for Theoretical Physics, Trieste (Italy). Mar 1989. 28p. Order Number DE89618396/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Stochastic differential equations describing the Markovian evolution of state vectors in the quantum Hilbert space are studied as possible expressions of a universal dynamical principle. The general features of the considered class of equations as well as their dynamical consequences are investigated in detail. The stochastic evolution is proved to induce continuous dynamical reduction of the state vector onto mutually orthogonal subspaces. A specific choice, expressed in terms of creation and annihilation operators, of the operators defining the Markov process is then proved to be appropriate to describe continuous spontaneous localization of systems of identical particles. The dynamics obtained in such a way leaves practically unaffected the standard quantum evolution of microscopic systems and induces a very rapid suppression of coherence among macroscopically distinguishable states. The classical behaviour of macroscopic objects as well as the reduction of the wave packet in a quantum measurement process can be consistently derived from the postulated universal dynamical principle. (author). 23 refs.

35274 (IFT-P–27/88) **Is higher-derivative gravity a good therapy to the causal pathologies of Goedel-type universes.** Accioly, A.J. Instituto de Fisica Teorica, Sao Paulo, SP (Brazil). 1988. 8p. Order Number DE89618429/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

The possibility of considering higher-derivative gravity as a therapy to the causal pathologies of Goedel-type universes is investigated. As a consequence an unusual cosmological solution is obtained.

35275 (IFT-P–28/88) **Gravitational nonminimally coupled electromagnetic fields: a possible solution to some idiosincrasies of Einstein-Maxwell theory.** Accioly, A.J. Instituto de Fisica Teorica, Sao Paulo, SP (Brazil). 1988. 37p. Order Number DE89618430/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A theory of nonminimal coupling of electromagnetism and gravitation in the framework of Riomannian geometry is constructed. As a consequence the main difficulties concerning the Einstein-Maxwell theory are cleared away. The theory works as a kind of correction to the Einstein-Maxwell one for regions with strong curvature and for times much greater than the Planck time. A Reissner-Nordstroem-type solution is exhibited and comments are made on a parameter which somewhat resembles the "Schwarzschild radius". A mechanism of charge creation via nonminimal coupling is also discussed. We calculate the propagation of photons in a Robertson-Walker background and find that the effect of the nonminimal coupling in this case may be to deviate the photon from the null geodesics, increasing its velocity beyond the flat-space value. Taking into account this results, the observed isotropy of the background radiation can be explained in a simple way, regardless of any assumption about the state of the Universe prior to the Planck time.

35276 (IFT-P–33/88) **Unusual cosmological solution in the context of higher-derivative gravity.** Accioly, A.J. Instituto de Fisica Teorica, Sao Paulo, SP (Brazil). 1988. 7p. Order Number DE89618431/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

A general vacuum solution to the higher-derivative gravity field equations is presented in case of a model that exhibits symmetries of the Goedel-type. The solution possesses unusual properties.

35277 (IFUSP-P–738) **On the quantization of chiral bosonic particles.** Gomes, M.; Rivelles, V.O.; Silva, A.J. da. Sao Paulo Univ., SP (Brazil). Inst. de Fisica. Sep 1988. 10p. Order Number DE89618397/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Starting from the classical of a left moving massless relativistic particle the quantization of chiral bosons is discussed. Using the Batalin-Fradkin-Vilkowski formalism the particle propagator is derived and the result is extended to a hidden soliton sector.

35278 (IFUSP-P–742) **Compton's Kinematics and Einstein - Ehrenfest's radiation theory.** Barranco, A.V.; Franca, H.M. Sao Paulo Univ., SP (Brazil). Inst. de Fisica. Sep 1988. 39p. Order Number DE89618398/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The Compton Kinematic relations are obtained from entirely classical arguments, that is, without the corpuscular concept of the photon. The calculations are nonrelativistic and result from Einstein and Ehrenfest's radiation theory modified in order to introduce the effects of the classical zero-point fileds characteristic of Stochastic Electrodynamics.

35279 (IFUSP-P–756) **Kosterlitz-thouless phase transition in two-dimensional hierarchical Coulomb gases.** Marchetti, D.H.U.; Perez, J.F. Sao Paulo Univ., SP (Brazil). Inst. de Fisica. Nov 1988. 30p. Order Number DE89618399/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A hierarchical version of two-dimensional lattice Coulomb gases is investigated. For $\beta>\beta_c = 8PI$ there is a locally stable line of fixed points for the Renormalization Group ('block charges') transformations. For $\beta>\beta^-_c$ ($\beta_c \leq \beta^-_c \leq 3PI/2\ \beta_c$), these fixed points are globally stable. As a consequence, there is no screening of external charges for any activity if $\beta > \beta^-_c$. At β_c a supercritical bifurcation takes place and the behavior of the model for $\beta <$ or approx., β_c as to show a weak form of screening, is investigated.

35280 (INIS-BR–1483, pp. 37) **Interface boudary conditions and non parabolicity effects in quantum wells.** Lopez G, J. (Havana Univ. (Cuba). Dept. of Theoretical Physics); Dios L, M. de; Sabin del V, J. Minas Gerais Univ., Belo Horizonte (Brazil). Dept. de Fisica. 1989. (CONF-8901126–: 4. Brazilian school of semiconductor physics, Belo Horizonte, Brazil, 23 Jan - 3 feb 1989). In *Proceedings of the 4. Brazilian School of Semiconductor Physics.* Order Number DE89612194/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

ALUMINIUM COMPOUNDS/electronic structure; ALUMINIUM COMPOUNDS/gallium arsenides; ELECTRONIC STRUCTURE/boundary conditions; ELECTRONIC STRUCTURE/hamiltonians; ELECTRONIC STRUCTURE/interfaces; GALLIUM ARSENIDES/electronic structure; HAMILTONIANS; INTERFACES; ENERGY-LEVEL TRANSITIONS; POTENTIALS

35281 (INIS-BR–1483, pp. 38) **Electric field effects on the electronic states of a quantum well.** Lopez G, J. (Havana Univ. (Cuba). Dept. of Theoretical Physics); Bruno, A.; Villares, A.; Enderleiu, R. Minas Gerais Univ., Belo Horizonte (Brazil). Dept. de Fisica. 1989. (CONF-8901126–: 4. Brazilian school of semiconductor physics, Belo Horizonte, Brazil, 23 Jan - 3 feb 1989). In *Proceedings of the 4. Brazilian School of Semiconductor Physics.* Order Number DE89612194/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

POTENTIALS/electronic structure; POTENTIALS/interfaces; POTENTIALS/quantum mechanics; ELECTRIC FIELDS; ENERGY LEVELS; POTENTIALS; INTERFACES; WAVE FUNCTIONS

35282 (INIS-BR–1483, pp. 43) **Resonant zener tunneling in quantum wells.** Levya, M.D. (Havana Univ. (Cuba). Dept. of Theoretical Physics); Lopez G, J. Minas Gerais Univ., Belo Horizonte (Brazil). Dept. de Fisica. 1989. (CONF-8901126–: 4. Brazilian school of semiconductor physics, Belo Horizonte, Brazil, 23 Jan - 3 feb 1989). In *Proceedings of the 4. Brazilian School of Semiconductor Physics.* Order Number DE89612194/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

POTENTIALS/quantum electronics; POTENTIALS/tunnel effect; ELECTRIC CONDUCTIVITY; ELECTRIC FIELDS; POTENTIALS; TRANSMISSION; VALENCE

35283 (INIS-BR–1483, pp. 44) **Resonant tunneling in quantum dots under transverse electric fields.** Valadares, E.C. (Sao Paulo Univ., SP (Brazil). Inst. de Fisica). Minas Gerais Univ., Belo Horizonte (Brazil). Dept. de Fisica. 1989. (CONF-8901126–: 4. Brazilian school of semiconductor physics, Belo Horizonte, Brazil, 23 Jan - 3 feb 1989). In *Proceedings of the 4. Brazilian School of Semiconductor Physics.* Order Number DE89612194/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

TUNNEL EFFECT/crystal structure; TUNNEL EFFECT/quantum electronics; TUNNEL EFFECT/transfer matrix method; ELECTRIC FIELDS; ELECTRONS; POTENTIALS

35284 (INIS-BR–1483, pp. 45) **Resonant magnetotunneling of electrons in double barrier heterostructures.** Valadares, E.C. (Sao Paulo Univ., SP (Brazil). Inst. de Fisica); Leite, J.R.; Studart, N. Minas Gerais Univ., Belo Horizonte (Brazil). Dept. de Fisica. 1989. (CONF-8901126–: 4. Brazilian school of semiconductor physics, Belo Horizonte, Brazil, 23 Jan - 3 feb 1989). In *Proceedings of the 4. Brazilian School of Semiconductor Physics.* Order Number DE89612194/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

TUNNEL EFFECT/crystal structure; TUNNEL EFFECT/electrons; TUNNEL EFFECT/transfer matrix method; DEGREES OF FREEDOM; DIAGRAMS; INTERFACES; MAGNETIC FIELDS; ELECTRONS

35285 (INIS-BR–1483, pp. 65) **Density of states of impurities in quantum-well wires.** Osorio, F.A.P. (Sao Paulo Univ., Sao Carlos, SP (Brazil). Inst. de Fisica e Quimica); Hipolito, O.; Silva, A.F. da. Minas Gerais Univ., Belo Horizonte (Brazil). Dept. de Fisica. 1989. (CONF-8901126–: 4. Brazilian school of semiconductor physics, Belo Horizonte, Brazil, 23 Jan - 3 feb 1989). In *Proceedings of the 4. Brazilian School of Semiconductor Physics.* Order Number DE89612194/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

POTENTIALS/quantum electronics; POTENTIALS/wires; WIRES/impurities; WIRES/quantum electronics; BINDING ENERGY; HEIGHT; POTENTIALS; WIRES; QUANTITY RATIO; SIZE; IMPURITIES

35286 (INIS-BR–1483, pp. 72) **Renormalization group study of electronic states on a fractal.** Barbosa, M.P. (Bahia Univ., Salvador (Brazil). Inst. de Fisica); Andrade, R.F.S. Minas Gerais Univ., Belo Horizonte (Brazil). Dept. de Fisica. 1989. (CONF-8901126–: 4. Brazilian school of semiconductor physics, Belo Horizonte, Brazil, 23 Jan - 3 feb 1989). In *Proceedings of the 4. Brazilian School of Semiconductor Physics.* Order Number DE89612194/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

FRACTALS/electronic structure; FRACTALS/hamiltonians; FRACTALS/renormalization; CRYSTAL LATTICES; ENERGY DENSITY; FRACTALS; HAMILTONIANS; RENORMALIZATION; GREEN FUNCTION; TRANSFER MATRIX METHOD

35287 (INIS-BR–1483, pp. 77) **New analytical approximation for the density of states of a disordered Bethe lattice.** Nascimento, L.C.S. do (Universidade Federal Fluminense, Niteroi, RJ (Brazil). Inst. de Fisica). Minas Gerais Univ., Belo Horizonte (Brazil). Dept. de Fisica. 1989. (CONF-8901126–: 4. Brazilian school of semiconductor physics, Belo Horizonte, Brazil, 23 Jan - 3 feb 1989). In *Proceedings of the 4. Brazilian School of Semiconductor Physics.* Order Number DE89612194/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

BINARY ALLOY SYSTEMS/analytical solution; BINARY ALLOY SYSTEMS/electronic structure; HAMILTONIANS

35288 (INIS-BR–1483, pp. 97) **Numerical Kronig - Pennel model to calculate band structure of quantum wells and semiconductor heterostructures.** Moreira, C.H.C. (Minas Gerais Univ., Belo Horizonte (Brazil). Dept. de Fisica); Alves, J.L.A. Minas Gerais Univ., Belo Horizonte (Brazil). Dept. de Fisica. 1989. (CONF-8901126–: 4. Brazilian school of semiconductor physics, Belo Horizonte, Brazil, 23 Jan - 3 feb 1989). In *Proceedings of the 4. Brazilian School of Semiconductor Physics.* Order Number DE89612194/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

ELECTRONIC STRUCTURE/numerical solution; ELECTRONIC STRUCTURE/quantum electronics; ELECTRONIC STRUCTURE/semiconductor materials; CRYSTAL GROWTH; DISPERSION RELATIONS; ELECTRON-HOLE DROPLETS; PHOTOLUMINESCENCE; POTENTIALS; SUPERLATTICES; VARIATIONAL METHODS; WAVE FUNCTIONS

35289 (INIS-SU–91) **Analytic Moufang-transformations.** Paal, Eh.N. AN Ehstonskoj SSR, Tallin (USSR). 1988. 22p. Order Number DE89618388/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The paper is aimed to be an introduction to the concept of an analytic birepresentation of an analytic Moufang loop. To describe the deviation of (S,T) from associativity, the associators (S,T) are defined and certain constraints for them, called the minimality conditions of (S,T) are established. Preprint F–46; 15 refs.

35290 (JINR-E–5-88-456) **Some exact solutions of the three-identical-particle problem with S-wave inverse square potentials.** Pupyshev, V.V. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics. 1988. 7p. Order Number DE89618402/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Submitted to Phys. Lett., A.

The existence criterion of exact solutions to the Schroedinger equation as a product of the Bessel function of the hyperradius and a finite sum hyperharmonics is proved within the Faddeev integrodifferential approach. 11 refs.; 1 tab.

35291 (JINR-R–2-88-441) **Retarded solutions and causality principle.** Shirokov, M.I. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics. 1988. 15p. (In Russian). Order Number DE89618404/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Submitted to the journal Usp. Fiz. Nauk.

It is shown that the retarded solutions of the quantum field equations appear in the prediction problem and the advanced ones appear in retrodiction. It is argued that the equations and their solution do not imply the causality principle (stating that the cause must precede the effect), the initial state of the system or an external action on it being considered as the cause. The 'time arrow' in the quantum mechanics is discussed in connection with the reduction of the state vector occuring in the measuring process. A new interpretation of Bogolyubov N.N. causality axiom is suggested. 28 refs.; 2 figs.

35292 (JINR-R–2-88-483) **Generally covariant representation of the Landau and Lifshitz pseudotensor.** Tentyukov, M.N. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics. 1988. 9p. (In Russian). Order Number DE89618432/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

The symmetrical second order tensor field describing the gravitation is considered on the four-dimensional affinely connected space without torsion. The expression corresponding to the Einstein superpotential usually used in the pseudotensor approach to the energy-momentum problem is defined by the variational method. The generalized Landau and Lifshitz superpotential is introduced by analogy with this expression. Then the tensor corresponding to the Landau and Lifshitz pseudotensor is defined. The investigation has been performed at the Laboratory of Theoretical Physics, JINR. 9 refs.

35293 (JINR-R–2-88-626) **Fundamental length and relativistic length.** Strel'tsov, V.N. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy. 1988. 2p. (In Russian). Order Number DE89618433/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

It si noted that the introduction of fundamental length contradicts the conventional representations concerning the contraction of the longitudinal size of fast-moving objects. The use of the concept of relativistic length and the following "elongation formula" permits one to solve this problem. 5 refs.

35294 (JINR-R–4-88-438) **Three-body molecular description of the transter reaction.** Matveenko, A.V. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics. 1988. 10p. (In Russian). Order Number DE89618405/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Submitted to the Organizing Committee of the 5-th International Conference on Cluster Aspects in Nuclear and Subnuclear Systems, Kyoto, Japan, July 1988.

A unified approach to the description of molecular states in a three-body system is proposed. The method is based on the old adiabatic idea of Born and Oppenheimer and in its present form looks like a modification of the hyperspherical adiabatic method. The proper choice of the coordinate system and the preliminary analytic analysis of the singularities of the problem are argued to be important for a further development of a powerful numerical procedure for solving the problem. 12 refs.; 3 figs.

35295 (JINR-R–17-88-349) **On some stochastic properties of the infinitely dimensional hamiltonian systems of classical mechanics.** Sankovich, D.P. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics. 1988. 10p. (In Russian). Order Number DE89618403/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Some simplest systems of the classical one-dimensional field theory is considered. For the nonlinear Schroedinger model the kinetic and hydrodynamic equations are obtained. For the one-dimensional Ginzburg-Landau type system by Bogolubov inequality the lower bound for the pair correlation function and average total momentum is obtained. In case of the cubic non-linearity (KdV-model) we attempt to do a hydrodynamic interpretation of the conservation laws and reductions arised in the model. 6 refs.

35296 (LBL–26953) **Theory of x-ray holography including phase and amplitude contrast and finite transfer functions.** Howells, M.R. Lawrence Berkeley Lab., CA (USA). Jan 1989. 13p. Sponsored by DOE Energy Research. DOE Contract AC03-76SF00098. Order Number DE89012835/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

We present the theory in broadly the same way as for visible holography, specializing to the Gabor, in-line case with plane-wave illumination, but allowing phase and amplitude contrast and a fairly general transfer function. Much of this theory is treated by a number of earlier authors but none with the particular choice of issues that we wish to address. These are those mentioned plus numerical reconstruction from a digitized hologram and of course application to the soft x-ray spectral range. For simplicity and clarity, we consider first an amplitude and phase object consisting of a single, on-axis pixel and an ideal, perfect transfer function. (12 refs., 4 figs.)

35297 (SAND–89-7082C) **A finite element method for solving electromagnetic scattering problems.** Cangellaris, A.C.; Lee, R. Sandia National Labs., Albuquerque, NM (USA). 1989. 3p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890660–8: Institute of Electrical and Electronics Engineers (IEEE) Antennas Propagation Society (AP-S) international symposium, San Jose, California, USA, 26-30 Jun 1989). Order Number DE89013496/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

One of the major issues associated with using the finite element method in opening regions is the problem of truncating the computational mesh. There have been numerous techniques which have been developed in the past several years. Hybrid finite element methods were first introduced by Silvester and Hsieh and McDonald and Wexler. They used a surface integral equation involving the appropriate Green's function that satisfies Sommerfeld's radiation condition at infinity to account for the truncation at the boundary. Mei developed an innovative method called the unimoment method that utilizes finite-element solutions inside a sphere containing the scatterer and eigenfunction expansions in the exterior of the sphere to compute the fields everywhere. Since then, several modifications and/or extensions of the aforementioned methods have appeared. In this paper, we present a new finite element formulation of the electromagnetic scattering problem. This new formulation could be thought of as a generalization of the unimoment method. Although our preliminary results are for two dimensional problems, the method can be extended to three dimensional geometries. 7 refs., 2 figs.

35298 (UCRL–53874) **Bidirectional Reflection Distribution Functions from surface bump maps.** Cabral, B.K. Lawrence Livermore National Lab., CA (USA). 17 Jun 1988. 74p. Sponsored by DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE89013712/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

Thesis. Submitted to Univ. of California, Davis.

The interaction of light and matter define what we see. This interaction can be characterized by a function which relates incoming light to the distribution of outgoing or reflected light. The Bidirectional Reflection Distribution Function (BRDF) is just such a function. Computer graphics scientists attempting to model this function have made simplifying assumptions about the reflecting surfaces. These simpler models have produced adequate results but only handle very uniform or isotropic surface characteristics. Reality on the other hand is filled with a variety of surface textures which result in a variety of BRDFs. This thesis broadens the class of BRDFs which can be used in computer graphics to render objects more realistically. It presents two enhancements to previous work done by the author. First, it describes a method for the approximation of surface absorption of light through the use of a computed geometric attentuation factor. This factor is computed by calculating the parts of the surface which are visible in the incident and reflecting directions. Specifically, it describes the algorithms and theory behind the visibility calculations and how it affects the reflection properties of the surface. Second, it describes a method for computing Fresnel's Law for conducting and dielectric surface materials and how Fresnel's Law affects surface reflectivity. This work also presents a method for rendering objects using the computed BRDFs. 38 refs., 29 figs., 2 tabs.

35299 **Rotational symmetry analysis for semiclassical and quantum mechanics.** Harter, W.G. (Univ. of Arkansas, Fayetteville (USA)). pp. 27 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

Rotational symmetry analysis has been applied to molecular structure determination. The presence of anisotropic potentials makes the problem analogous to the quantum mechanics of rotation. Approximations are made relating tensor matrix elements of high J and K states to asymptotic expressions for the Clebsch Gordan coefficient. Examples are given of J-phase trafectories on rotational energy (RE) surfaces. The magnitude of J is a constant on the RE surfaces.

35300 **Algebraic approach to molecular spectra and dynamics.** Levine, R.D. (Hebrew Univ., Jerusalem (Israel)). pp. 12 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

Algebraic Hamiltonians which are bilinear in the generators of a Lie group provide an accurate yet practical description of molecular spectra even in the highly anharmonic regime. The approach can be extended, in a phenomenological fashion, to larger molecules. The group representations provide a basis in which other molecular properties can be computed. In particular, the scattering and transition amplitudes can be so determined.

35301 **Dynamical symmetries in nuclear structure.** Casten, R.F. (Brookhaven National Lab., Upton, NY (USA)). pp. 28 of Group

theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). DOE Contract AC02-76CH00016. (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

In recent years the concept of dynamical symmetries in nuclei has witnessed a renaissance of interest and activity. Much of this work has been developed in the context of the Interacting Boson Approximation (or IBA) model. The appearance and properties of dynamical symmetries in nuclei will be reviewed, with emphasis on their characteristic signatures and on the role of the proton-neutron interaction in their formation, systematics and evolution.

35302 Fermion dynamical symmetry model and nuclear structure. Wu, C. (Drexel Univ., Philadelphia, PA (USA)). pp. 26 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

A fermion dynamical symmetry model (FDSM) for the structure of nuclei is presented. The model has a SU_3 rotational limit, a SO(6) γ-soft limit and three vibrational limits (SU_2, SO_7 and $SO_5 \times SU_2$), with fully microscopic connections between these dynamical symmetries and the underlying shell structure. It is shown that both the phenomenological Interacting Boson Model (IBM) and the Geometrical Model (GM) can be recovered from this model under certain approximations.

35303 Group theory approach to scattering. Iachello, F. (Yale Univ., New Haven, CT (USA)). pp. 18 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). DOE Contract AC02-76ER03074. (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

The group theory approach to scattering developed recently by several authors is reviewed. In particularly, the concept of Euclidean connection which allows a purely algebraic determination of the S-matrix is introduced and discussed.

35304 Algebraic methods in medium energy scattering from nuclei and molecules. Amado, R.D. (Univ. of Pennsylvania, Philadelphia (USA)). pp. 2 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

The theoretical development and application to diatomic molecules is presented for medium energy scattering from complex quantum targets. Medium energy is defined as an energy that is large compared with the collective states of the target.

35305 Group theoretical approach to scattering. Biedenharn, L.C. (Duke Univ., Durham, NC (USA)); Stahlhofen, A. pp. 12 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

The group theoretic approach to scattering is discussed using the concept of the factor space of scattering. The authors give a detailed discussion of relativistic SO(3,1) scattering for spin 1/2 particles, and sketch the Dirac-Coulomb problem as an example of broken symmetry. An addendum clarifies misunderstandings related to the use of the Euclidean group.

35306 Violation of periodic symmetry in quasicrystals. Kramer, P. (Institut fuer Theoretische Physik der Universitaet, Tuebingen (West Germany)). pp. 16 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

It seems that with quasicrystals the authors are entering a new field of ordered structures in the solid state. There is a wealth of new experimental information based on advanced techniques for probing these new materials. In the theory one must understand the new physics of this order and develop the fields which so far have been explored for periodic order. The violation of periodic symmetry is a challenge to their imagination. Required are tools of high-dimensional crystallography, from the geometry of lattices, from quasiperiodic functions and Fourier transform theory. Groups and their representations, which are the subject of this contribution, will play a key role in the theory of non-periodic order in solids.

35307 Growth of quasicrystals. Elser, V. (AT and T Bell Labs., Murray Hill, NJ (USA)). pp. 22 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

Certain random packings of regular decagons in the plane are equivalent to two dimensional surfaces defined on a four dimensional lattice. The controlled generation of such surfaces corresponds to a physical model of quasicrystal growth. Computer experiments are described where the thermal gradient, growth velocity, and relative angle between growth direction and decagon axes are varied. The results suggest an entropic mechanism for (near) decagonal order. Geometrically, the anisotropy introduced by the growth conditions create a tilt in the surface while spatial nonuniformity in the growth conditions generates tears. Analogues of these effects in three dimensions are able to explain the peculiar pattern of shifts, and the large widths, of peaks in diffraction from icosahedral phase.

35308 Hausdorff dimension of irrational windings. Cvitanovic, P. (Niels Bohr Institute, Copenhagen (Denmark)). pp. 15 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

The author uses the thermodynamical formalism to obtain estimates of the Hausdorff dimension of the fractal set formed by the irrational winding parameter values of critical circle maps, and elucidate its conjectured universality. The author investigates in detail the Farey level definition of the Hausdorff dimension. The author finds that in this version of the thermodynamic formalism the Hausdorff dimension marks a phase transition from harmonic to geometric scalings.

35309 Number of periodic windows in one-dimensional mappings. Hao, B. (Institute of Theoretical Physics, Beijing (China)); Zeng, W. pp. 17 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

The total number of periodic windows in one-dimensional mapping may be related to several other enumeration problems, in particular, to the number of symmetry types of periodic sequences. The latter problem has been studied by mathematicians for a long time. However, to apply their results to mappings one must be careful in choosing the correct group, as it is shown in the example of the antisymmetric cubic map.

35310 Generalized symmetries. Olver, P.J. (Univ. of Minnesota, Minneapolis (USA)). pp. 13 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

A summary of the basic theory of generalized symmetries of partial differential equations and connections with conservation laws is presented. This is followed by a summary of recent applications to different area of mathematical physics.

35311 What is new in the study of differential equations by group theoretical methods?. Winternitz, P. (Universite de Montreal, Quebec (Canada)). pp. 20 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte.

Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

Several recent developments have made the application of group theory to the solving of differential equations more powerful than it used to be. The ones discussed here are: (1) The advent of symbol manipulating computer languages that greatly simplify the construction of the symmetry group of an equation. (2) Methods of finding all subgroups of a given Lie symmetry group. (3) The theory of infinite dimensional Lie algebras. (4) The combination of group theory and singularity analysis.

35312 Approximate global symmetries of the electroweak interactions. Georgi, H. (Boston Univ., MA (USA)). pp. 9 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

The author discusses and exemplifies a simple explanation for the approximate symmetries of the electroweak interactions that arises naturally in models in which the quarks, leptons and Higgs particles are all composite states of strongly interacting fermions.

35313 Quasi-lattices associated with arbitrary groups: Application to icosahedral and dihedral groups. Haase, R.W. (Technische Universitaet Wien (Austria)); Kramer, P. pp. 6 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

A systematic approach is given for the construction of families of polytopes associated with a given group G and subgroup H. The emphasis is placed on the role of the induced representation theory and project to E_3. This procedure is applied to both the icosahedral group J, the dihedral group D_{10} and its isomorphic group C_{10v}. They provide various types of quasi-lattices associated with these groups and hence are candidates for modelling the quasi-crystalline structures for the icosahedral and decagonal phases of aluminum-transition metal alloys.

35314 Symmetry and subgroups of the regular tetrahedron in 4-dimensions. Deonarine, S. (Bronx Community College of City Univ. of New York, NY (USA)); Birman, J.L. pp. 6 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

The 384 point symmetry operations of G_0 the group of the regular tetrahedron in 4-dimensions, are given in terms of permutations on 8-symbols. All subgroups $G \subset G_0$ are derived using Group Representation theory. These are presented in a family-tree of subgroups. Some applications are discussed.

35315 Symmetry of quasiperiodic lattices and decomposability of crystallographic point groups. Lu, J.P. (City College of the City Univ. of New York, NY (USA)); Birman, J.L. pp. 8 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

A new classification scheme for all quasilattices in N dimensions is obtained, based on embedding the quasilattice in an $M > N$ dimensional periodic lattice. M is the number of independent lattice vectors needed to index the quasilattice over the integer field. The authors show that each R-decomposable and Q-irreducible crystal group in M dimensions gives rise to a quasilattice in lower dimension; the quasilattice so obtained has either the full symmetry group or is a subgroup of the periodic lattice. If Q-irreducibility is restricted to N dimensions, one obtains a class of N-Dimensional quasilattices which can be embedded in M dimensions. A full example is worked out for M=4, N=2.

35316 Tensorial properties distinguishing icosahedral symmetry from cubic or isotropic SO(3) symmetry. Goshen, S.Y. (Nuclear Research Center, Beer-Sheba (Israel)); Birman, J.L. pp. 4 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

A method is given by which tensor response functions can be calculated for icosahedral, cubic and isotropic systems. New components can appear in third and higher order tensor response (or compliance) effects.

35317 Symmetry and phase transitions in decagonal quasicrystals. Litvin, D.B. (City College of the City University of New York, NY (USA)); Kopsky, V.; Birman, J.L. pp. 6 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

The possible non-crystallographic point group of the decagonal quasi-crystal phase of Al-Mn alloys has been shown by Bendersky to be either C_{10h} or D_{10h}. For the physically irreducible representations of these groups, the authors derive the extended integrity basis, Clebsch-Gordan products, stability spaces, and tensorial covariants. The point groups which can arise in phase transitions are determined. It is shown that equilibrium tensori properties whose components transform as the components of the electrogyration or electrostriction tensors can distinguish between the $C_{10h}$and d_{10h} point group symmetry of the decagonal phase.

35318 Group theory and elasticity of quasicrystals. Jaric, M.V. (Texas A and M Univ., College Station (USA)). pp. 6 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

A calculation of elastic constants of quasicrystals leads to an interesting use of invariant theory. The author first derives a general result for G-invariant sums over G-covariants. Then, they give the explicit forms of the relevant basic elasticity tensors for icosahedral quasicrystals. The author suggests a particularly convenient coordinate system for the elasticity tensor.

35319 Dynamical group approach to certain anharmonic oscillator and perturbed Coulomb potentials. De Meyer, H. (State Univ. of Ghent (Belgium)); Vanden Berghe, G.; Fack, V. pp. 5 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

It is discussed how the SO(2,1) dynamical group formalism combined with algebraic perturbation theory leads to high accuracy approximations for the bound state energies of the anharmonic oscillator potential $V(x) = X^2 + \lambda x^2/(1+gx^2)$ and of the exponential cosine screened Coulomb potential $V(r) = -\exp(-\lambda r)\cos(\mu r)/r$.

35320 Symmetry-conserving higher-order interaction terms in the I.B.A.-model: the O(6) limit. Vanden Berghe, G. (State Univ. of Ghent (Belgium)); Vanthournout, J.; Van der Jeugt, J.; De Meyer, H. pp. 5 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

Explicit matrix elements are found for the generators of the group O(6) in an arbitrary totally symmetric irreducible representation, using the physical principal SO(3) subgroup in the chain $SO(6) \supset SO(5) \supset SO(3)$. It is shown that the obtained reduced matrix elements can be used to calculate closed analytical forms for the eigenvalues of third-order SO(3) scalar operators which can play a role in the description of the O(6) limit of the I.B.A.-model. A comparison with experimental data is given.

35321 Algorithms for supercomputers. Alder, B.J. (Lawrence Livermore National Lab. (US)). v.v of Supercomputer simulations in chemistry. Dupuis, M. Springer-Verlag New York Inc., New York, NY (1986). (CONF-8508156–: Conference on supercomputer simulations in chemistry, Montreal, Canada, 25-27 Aug 1985).

Better numerical procedures, improved computational power and additional physical insights have contributed significantly to progress in dealing with classical and quantum statistical mechanics problems. Past developments are discussed and future possibilities outlined.

35322 Classification of symmetry preserving cubic interactions in the interacting boson model. De Meyer, H. (State Univ. of Ghent (Belgium)); Van der Jeugt, J. pp. 5 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

It is shown that the most general I.B.M.-Hamiltonian contains 17 independent Hermitian cubic interaction terms. Their explicit structure in terms of the U(6) generators is established. A similar analysis is also made for each of the dynamical symmetry limits.

35323 Algebraic foundation for the triaxial rotor. Draayer, J.P. (Louisiana State Univ., Baton Rouge (USA)); Leschber, Y. pp. 6 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

The SU(3) → SO(3) group structure is shown to support the dynamics of a triaxial quantum rotor. Specifically, a simple analytic result is given for mapping from the rotor hamiltonian to its fourth-order SU(3) → SO(3) integrity basis image. An important feature of the mapping is that it carries invariants of the rotor into Casimir invariants of SU(3). Results for spectra and transition rates are used to demonstrate the effectiveness of the mapping. The theory gives physical significance to operators first introduced by Racah in his attempt to provide a canonical resolution of the SU(3) → SO(3) state-labelling problem.

35324 Spin quenching and the SO_8 and SP_6 fermion models of collective motion. Ginocchio, J.N. (Los Alamos National Lab., NM (USA)). pp. 4 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

The author shows that within the SO_8 model the expectation value of the spin operator in the subspace consisting only of $J^\pi = 0^+, 2^+$ pairs only is reduced in magnitude with respect to the single-particle expectation values of the spin operator.

35325 U(6,1) model of pairing and quadrupole collectivity. Rosensteel, G. (Tulane Univ., New Orleans, LA (USA)). pp. 6 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

An algebraic structure is developed to unify the Interacting Boson Model (IBM) and the Noncompact Symplectic Model for nuclear structure physics. A particular goal is the understanding of the effects on IBM valence space renormalization of excitations of the nuclear core. An excellant candidate for the unifying algebraic structure is shown to be the noncompact unitary algebra u(6,1).

35326 Theorem on the Schwinger representations of Lie groups and its application to the algebraic Hamiltonian for diatomic molecules. Kim, S.K. (Temple Univ., Philadelphia, PA (USA)). pp. 5 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

A general transformation theory has been developed for boson operators utilizing a Lie group Schwinger representation. It is shown that this theory can be applied to the most general albegraic Hamiltonian for a diatomic molecule based on the U(4) vibron model. This comes about from an extension of earlier word which utilized fourth order generators of U(4) to describe the rotational and vibrational degrees of freedom.

35327 Group theoretical techniques for molecular electronic spectra. Lemus, R. (Centro de Estudios Nucleares (Mexico)); Frank, A.; Iachello, F. pp. 6 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

The authors present a general algebraic description of electronic-rotation-vibration spectra for diatomic molecules. A complete basis for the united atoms limit is constructed and matrix elements of interaction terms evaluated in closed form. Some applications are discussed.

35328 Algebraic approach to collision dynamics of composite projectiles. Berman, M. (Hebrew Univ., Jerusalem (Israel)); Levine, R.D. pp. 8 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

The time evolution of the density matrix in nuclear or molecular collision can be treated by algebraic techniques within the maximum entropy formalism. The same approach can also be used to propagate pure states. This algebraic approach has now been implemented in full detail. An illustrative example is briefly presented.

35329 Algebraic method for relativistic systems - spectrum and radiative transitions. Bohm, A. (Univ. of Texas, Austin (USA)); Loewe, M.; Magnollay, P. pp. 8 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

Hadron resonances are described as excited states of a quantal relativistic oscillator. Radiative transitions are calculated from a postulated coupling of the oscillator to the electromagnetic field.

35330 Dynamical SU(8) - a laboratory for phase coexistence. Solomon, A.I. (Open Univ., Milton Keynes (England)); Birman, J.L. pp. 5 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

The authors consider a model hamiltonian for the coexisting many-electron phenomena of superconductivity, charge density waves and ferro and anti-ferromagnetism. The spectrum-generating algebra (SGA) for such a model is su(8). They identify all 63 generators of this Lie algebra in physically meaningful bases for which the Cartan elements correspond to symmetries conserved at high temperature. The remaining 56 generators are shown to correspond to the order parameters of the various phases present in the model. A chain of subalgebras is exhibited, and the associated phenomena identified.

35331 Discrete symmetries and selection rules in unified SU(8) for superconductivity and density waves. Birman, J.L. (City College of the City Univ. of New York, NY (USA)); Solomon, A.I. pp. 6 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

The authors show that a discrete T symmetry produces selection rules which require certain order parameters to vanish.

35332 Diamond solvable Lie group and fiber optical communication systems. Schempp, W. (Univ. of Siegen (West Germany)). pp. 11 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

It is the purpose of this paper to show that harmonic analysis on the diamond solvable Lie group allows them to compute explicitly the quantized transverse eigenmode spectrum of optoelectronic devices used in fiber optical communication systems. As a result, the coupling coefficients of optoelectronic devices are expressed in terms of Krawtchouk polynomials.

35333 Dynamical groups in Lie optics. Wolf, K.B. (Universidad Nacional Autonoma de Mexico). pp. 6 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

The author reviews the state of Lie optics regarding the role of symmetries, dynamics, and phase space. It is suggested that a Euclidean algebra should be the subject of quantization to effect the passage between geometrical and wave optics.

35334 Symmetries of linear Newtonian systems. Lopez, A.G. (Princeton Univ., NJ (USA)). pp. 6 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

Several new results in connection with the structure of the Lie algebras of symmetries and of variational symmetries of arbitrary linear systems of second-order ordinary differential equations are reported.

35335 SU(1,1) coherent states and squeezed light interacting with an anharmonic oscillator. Gerry, C.C. (Saint Bonaventure Univ., NY (USA)). pp. 5 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

The authors consider a solvable model of a nonabsorbing nonlinear medium modelled as an anharmonic oscillator interacting with squeezed light described as an SU(1,1) coherent state. They find that the squeezing is eventually revoked and furthermore, the greater the initial squeezing, the more rapidly it is revoked.

35336 Symplectic decomposition of reaction channels. Kramer, P. (Institut fuer Theoretische Physik der Universitaet Tuebingen (West Germany)); Papadopolos, Z. pp. 8 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

The channels in a nuclear reaction are characterized by unitary and symplectic quantum numbers. For partners with $s^4p^{\cdot\cdot}$ configuration, unitary and symplectic principles exclude the formation of the lowest shell model compound states and lead to the occurrence of molecular resonances. The authors study the decomposition of some channel states w.r.t. the symplectic states.

35337 Group theoretical approach to squeezed states using generalized bose operators. Katriel, J. (Israel Institute of Technology, Haifa); Rasetti, M.; Solomon, A.I. pp. 5 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

Generalized, k-boson Holstein-Primakoff realizations of SU(2) and SU(1,1) are introduced in terms of generalized bose operators. The corresponding group theoretical coherent states are studied with respect to their squeezing properties relative to k-boson dynamical variables.

35338 Hidden symmetries and stereographic projection in rank one symmetric spaces. Perline, R. (Drexel Univ., Philadelphia, PA (USA)). pp. 3 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

The author discusses stereographic projection in euclidean, Minkowski, and hyperbolic space, and their applications to demonstrating hidden symmetries of mechanical systems. Generalizations to rank one symmetric spaces are considered.

35339 Properties of the strong factor in dynamically generated S-matrices. Amado, R.D. (Univ. of Pennsylvania, Philadelphia (USA)); Sparrow, D.A. pp. 6 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

The group theoretic S-matrix of Alhassid, Iachello and Wu is factorable into a product of Coulomb and strong factors. The strong factor is examined with a view to relating it to more familiar potential and phase shift descriptions. The authors find simple approximate expressions for the phase shifts which are very accurate for heavy-ion type applications. For peripheral scattering it is possible to obtain simple expressions relating the AIW strong factor to an effective potential.

35340 Group deformations and dynamic symmetries in scattering systems. Frank, A. (Universidad Nacional Autonoma de Mexico). pp. 6 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

It is shown that the group theoretical mechanisms of contraction and expansion can be applied for the derivation of recurrence relations associated to S matrices. The contraction describes the distortion of physical states when evolving from one kind of symmetry to another. The method is illustrated for a one dimensional scattering model involving the SO(2,1) group, which already displays much of the structure arising in higher dimensional systems.

35341 Group contraction and the algebraic approach to scattering. Celeghini, E. (Dipartimento di Fisica dell'Universita, Firenze (Italy)); Iachello, F.; Tarlini, M.; Vitiello, G. pp. 9 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

The authors show that links and formal analogies can be established between the formalism of the algebraic approach to scattering and that of spontaneous symmetry breaking. The dynamical rearrangement of the symmetry is shown to be a common feature of both formalisms. This observation gives a new perspective to the problem and provides clues for the extension of the algebraic approach to more complex situations.

35342 Symmetries of some hypergeometric series: implications for 3j- and 6j-coefficients. Louck, J.D. (Los Alamos National Lab., NM (USA)); Beyer, W.A.; Biedenharn, L.C.; Stein, P.R. pp. 7 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

The occurrence of generalized hypergeometric series as factors in the Wigner-Clebsch-Gordan (3j) and Racah (6j) coefficients is well known. The recently discovered S_5 symmetry of the Saalschuetzian ${}_4F_3$ series may be used to extend the symmetries of the 6j-coefficients to the much larger group generated by S_5 and the group of Regge symmetries. (A similar extension may be carried out for the 3j-coefficients.) The required extension of the domain or definition of the 6j-coefficients and the properties of its symmetry group is developed here.

35343 Nonlinear differential equations with superposition laws for the osp(1,2) superalgebra. Gagnon, L. (Univ. de Montreal, Quebec (Canada)); Beckers, J.; Hussin, V.; Winternitz, P. pp. 5 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical

methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

The theory of nonlinear ordinary differential equations with superposition principles is generalized to the superequations based on the osp(1,2) superalgebra. A superposition formula is then obtained.

35344 Symmetry groups of partial differential equations associated with vector-valued differential forms. Papachristou, C.J. (Brigham Young Univ., Provo, UT (USA)); Harrison, B.K. pp. 6 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110--: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

An older geometric technique employing exterior differential forms for the study of symmetry groups of partial differential equations is generalized and extended to problems involving sets of vector-valued differential forms. Application is made to the classical Yang-Mills equations.

35345 Horizontal constraints, Clebsch potentials and variational principles on principal fiber bundles. Cendra, H. (Universidad Nacional, Bahia Blanca (Argentina)); Ibort, L.A.; Marsden, J.E. pp. 5 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110--: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

The authors generalize the geometrical description of Lin constraints and variational principles in terms of Clebsch variables to configuration spaces that are non-trivial principal fiber bundles of structural group G. The generalization is intended to describe problems such as fluids with free boundaries or Yang-Mills fields.

35346 Symmetry reduction for the Kadomtsev-Petviashvili equation and its Baecklund transformation. David, D. (McGill Univ., Montreal, Quebec (Canada)). pp. 6 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110--: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

The infinite dimensional symmetry group of the potential Kadomtsev-Petviashvili (PKP) equation is found and applied to its Baecklund transformation (BT). The method of symmetry reduction is then applied to the PKP equation, and simultaneously to its BT. This yields new solutions to the KP equation.

35347 Hierarchies of symmetries and conserved functionals of the Federbush model. Kersten, P.H.M. (Univ. of Twente (Netherlands)). pp. 18 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110--: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

The Lie algebra of Lie-Baecklund transformations of the Federbush model is discussed. Relying on the grading of the model, first and second order (x,t)- independent Lie-Baecklund transformations are obtained. The construction of four creating and annihilating Lie-Baecklund transformations, which turn out to be local, is given. These transformations, which are polynomial of degree one in x and t, generate four hierarchies of Lie-Baecklund transformations. Finally, due to the construction of two Lie-Baecklund transformations which are polynomial of degree two in x and t, the authors obtain an infinite number of hierarchies of Hamiltonian vector fields. The corresponding Hamiltonian densities are given. All results are obtained by symbolic computation, using REDUCE 3 and developed software packages.

35348 Levi-Civita, Kustaanheimo-Stiefel and other transformations. Lambert, D. (Universite Catholique de Louvain (Belgium)); Kibler, M. pp. 6 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110--: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

Nonbijective quadratic transformations which generalize the LC transformation and the KS transformation are defined in an algebraic framework based on the use of Cayley-Dickson algebras of dimension n {<=} 8. The general algebraic framework sketched here allows them to generate other (nonbijective) quadratic transformations besides the LC- and KS-like transformations. The KS- and LC-like as well as the other transformations are investigated from a geometrical viewpoint. It appears that they are connected to Hopf and pseudo-Hopf fibrations.

35349 Spin structure, projection operators, and Bose-Fermi equivalence on the 2d torus for simply laced groups. Redlich, A.N. (Theoretical Particle Physics Institute for Advanced Study, Princeton, NJ (USA)). pp. 6 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110--: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

It is shown that projection operators - equivalent to summing over generalized spin structures - are essential for bose-fermi equivalence on the two-dimensional torus for all of the simply laced groups. An explicit calculation of the bosonic and fermionic partition functions is given for the simplest case: the adjoint representation of spin (2N).

35350 Representation of the generators of symplectic algebras. Chacon, E. (Instituto de Fisica (Mexico)); Moshinsky, M. pp. 5 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110--: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

In this note the authors outline a procedure for obtaining the matrix representation of the generators of a symplectic Lie algebra of an arbitrary number of dimensions, when the irreps are in the positive discrete series. These results are relevant to the matrix representation of Hamiltonians in the symplectic model of the nucleus.

35351 New perspective on the U(n) Wigner-Racah calculus. Le Blanc, R. (Univ. of Michigan, Ann Arbor (USA)); Hecht, K.T. pp. 6 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110--: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

Recent developments in the theory of group and tensor representations has enabled the authors to shed a new light on the U(n) Wigner-Racah calculus.

35352 SU(n) representation theory in terms of pseudo-unitary groups. Quesne, C. (Universite Libre de Bruxelles, Brussels (Belgium)). pp. 6 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110--: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

The complementarity relation between U(n) and U(p,q) within some positive discrete series irreps of a larger U(pn,qn) group is reviewed and used to construct SU(n) models and to solve the SU(n) external state labelling problem.

35353 Integral-spin fields on 3+2 de Sitter space. Gazeau, J.P. (Universite Paris (France)); Hans, M. pp. 6 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110--: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

Irreducible or nondecomposable representations of the de Sitter group SO(3,2) are extensively studied. Corresponding carrier states and invariant two-point functions are built through recurrence formula. The problems of light-cone propagation and reverberation phenomenon are examined. A particular emphasis is given on the so-called massless nondecomposable representations with arbitrary spin, with the following result: for a certain choice of the gauge-fixing parameter, the carrier states propagate only on the light-cone.

35354 Phase-space formalism for quantized fields. Kaiser, G. (Harvard Univ., Cambridge, MA (USA)). pp. 6 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110--: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

Quantum Field Theory is shown to possess a natural representation of the coherent-state type, based on solid physical principles such as the positivity of the energy and relativistic covariance. Quantized fields, initially defined over spacetime, are seen to extend canonically to a complex four-dimensional domain which, they carefully show, can be viewed as an extended, covariant classical phase space for the particles associated with the theory. Observables such as charge, 4-momentum etc. have simpler expressions in this formalism, and the corresponding currents in phase space can be displayed as regularizations of the usual ones in spacetime. However, they suggest that it is just as natural to take the view that the phase-space formulation is primary and the spacetime formulation is a singularization obtained by going to boundary-values. Examples of the improved regularity of their formalism are: Klein-Gordon particles in phase space possess a genuine (i.e., positive) probability current; Dirac particles in phase space undergo no Zitterbewegung; all particles are covariantly extended in space rather than being point-particles; quantized fields are operator-valued analytic functions rather than distributions.

35355 Unitary representations of diffeomorphism groups and unusual particle statistics. Goldin, G.A. (Rutgers, the State Univ., New Brunswick, NJ (USA)). pp. 6 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110--: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

In quantum theory unitary irreducible representations of Diff(M) and related groups describe many different physical systems, including particles obeying Bose, Fermi, or para statistics for $M = R^3$, and Θ-statistics for $M = R^2$. This paper reports progress in the group-theoretic description of such systems, for example: (1) exchange symmetry must be defined with respect to particle permutations rather than label permutations; and (2) braid group statistics can occur for particles with internal degrees of freedom such as quantum dipoles in R^2 or S^2.

35356 Unitary representations of photon polarization vectors. Han, D. (NASA - Goddard Space Flight Center, Greenbelt, MD (USA)); Kim, Y.S.; Noz, M.E. pp. 5 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110--: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

Lorentz transformation properties of free photons are studied within the framework of Wigner's little group for massless particles. It is shown that every four-by-four non-unitary matrix applicable to a photon polarization vector can be converted to a rotation matrix through a gauge transformation.

35357 Non-linear representations of the Poincare group in 3 and 4 space-time dimensions. Rideau, G. (Universite Paris (France)). pp. 6 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110--: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

Non-linear partial differential equations covariant with respect to the Poincare group generate non-linear representations of this group realized on the space of initial data. A basic problem is to learn if these particular representations are linearizable or not. This leads to the more general problem of classifying a priori the non-linear representations of the Poincare group up to an (generally non-linear) equivalence. The authors give here some partial results for the Poincare groups in 3 and 4 space-time dimensions which prove at least formally the existence of non-linear and non-linearizable representations.

35358 Differential geometry and gauge structure of maximal-acceleration invariant phase space. Brandt, H.E. (Harry Diamond Labs., Adelphi, MD (USA)). pp. 9 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110--: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

Maximal-acceleration invariant phase space is treated as a fiber bundle in which the base manifold is spacetime and the fiber manifold is four-velocity space. The differential geometry of the fiber bundle is developed in terms of a noncoordinate basis. The commutation coefficients of the anholonomic basis are calculated, and the gauge potential is shown to be the inner product of the spacetime affine connection and the four-velocity.

35359 New geometric symmetries via nonlinear realizations. Dalton, B.J. (Saint Cloud State Univ., MN (USA)). pp. 6 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110--: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

Limited nonlinear realizations of the Lorentz Group as transformations that mix the local four-velocities with fields, leaving invariant the Minkowski metric form $x_\mu x_\mu$ have been presented in earlier work. Here the authors show that limited extensions of these types of realizations to groups beyond the Lorentz Group, leaving $x_\mu x_\mu$ invariant, are possible. These realizations affect the x_μ only in the presence of fields. New realizations of SU(2), SU(2) x U(1), SU(2) x SU(2), and the translation group are presented. Limitations, possible extensions and physical implications are discussed.

35360 Neutrino mass and double beta decay. Kayser, B. (National Science Foundation, Washington, DC (USA)). pp. 5 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110--: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

Considerable efforts both theoretical and experimental are being expended to determine the neutrino mass. All existing versions of grand unified theory predict a neutrino mass based on location with massive particles in a unifying group. Double beta decay and solar neutrino measurements have failed to record a neutrino mass. Studies of the beta decay of tritium seem to have determined a sum of neutrino mass eigenstates for all allowed emissions. The mass of the electron neutrino awaits final determination.

35361 Applications of the three-dimensional ϕ^6-model to structural phase transitions. Grundland, A.M. (Memorial Univ. of Newfoundland, Saint John's (Canada)); Tuszynski, J.A.; Winternitz, P. pp. 12 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110--: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

A systematic investigation has recently been completed into the nonlinear Klein-Gordon equation which is an equation of motion for a scalar order parameter in second and first order phase transitions. In this paper they apply the symmetry reduction method to obtain the results relevant for structural phase transitions. The many attempts made in the past employed one-dimensional solutions. Here, they interpret the various three-dimensional exact solutions as homogeneous phases, domain walls, nucleation centers, phonons and defect structures. They also outline further calculations leading to a direct comparison with experiment.

35362 Explicit expression for the product of the class of transpositions with an arbitrary class of the symmetric group. Katriel, J. (Univ. of Waterloo, Ontario (Canada)); Paldus, J. pp. 4 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110--: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

An expression for the product of the class operator of the transpositions with an arbitrary class operator of the symmetric group is derived. The derivation is purely combinatorial, using no information from character theory.

35363 Recent results on group decompositions and some applications. Hebda, J. (Saint Louis Univ., MS (USA)); Moylan, P. pp. 6 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

Given a connected Lie group G and a closed connected subgroup H of G the authors give a necessary and sufficient condition that G decomposes into the cartesian product of G/H and H. They apply this criterion to a number of physically interesting situations which involve de Sitter and anti-de Sitter space. Finally they given an application to the conformal invariance of wave equations on de Sitter space.

35364 Representations of the Lie superalgebra G(3). Sciarrino, A. (Universita de Napoli (Italy)); Sorba, P. pp. 9 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

A method to build up explicitly the content into SU(2) x G_2 irreducible representations for typical as well as atypical representations of the exceptional Lie superalgebra G(3) is presented. Young supertableaux are introduced to describe representations of G(3).

35365 Principal subalgebras of Lie superalgebras and unimodality. Van der Jeugt, J. (State Univ. of Ghent (Belgium)). pp. 5 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

A short review of some properties of the principal three-dimensional subalgebra (TDS) of a simple Lie algebra including the unimodality of principally specialized characters is given. For Lie superalgebras, the situation is more complicated. First, a classification is obtained of those Lie superalgebras which contain a principal five-dimensional subalgebra (FDS). Then, the unimodality of principally specialized characters of typical finite-dimensional modules is discussed, and some applications are mentioned.

35366 Generally covariant quantum field theory. Haag, R. (Institut fuer Theoretische Physik der Universitaet Hamburg (West Germany)). pp. 2 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

A synthesis is performed of the essential principles of general relativity with those of quantum theory. Germs are defined and used to reconstruct the theory. It is shown that with consideration of certain restricted states, the germs form a sheaf corresponding precisely to the desired merged theories.

35367 Covariance representation of global quantum dynamics and its symmetries. Rieckers, A. (Institut fuer Theoretische Physik Universitaet Tuebingen (West Germany)). pp. 5 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

A method is presented for implementing the dynamics and symmetries of a global quantum description by pairs of partial isometries and for separating the part which is continuous in the group parameter.

35368 Quantum De Sitter structured connection and an example: the quantum relativistic rotator. Aldinger, R.R. (Eastern Illinois Univ., Charleston (USA)). pp. 6 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

The relationship between the gauge-theoretic and geometrical aspects of the structure of isolated (neutral) hadronic bound states is considered by analyzing the gauge theory of a de Sitter SO(4,1). The analysis is based on Drechsler's soldered de Sitter fiber bundle which possesses as its fiber a four-dimensional pseudo-Riemannian space of constant negative curvature characterized by a radius R of the order of 10^{-13}cm. The structure group of the bundle is a de Sitter SO(4,1) which contains translations as well as rotations all of which are initially on an equal footing. A scaling of 4 of the 10 generators of SO(4,1) breaks the original symmetry down to the Lorentz SO(3,1) which, after quantization in the inertial gauge, leads to the experimentally verifiable hadron model of the quantum relativistic rotator.

35369 Infinite dimensional Lie algebras acting on the solution space of σ models with a Wess-Zumino term. Saint-Aubin, Y. (Universite de Montreal, Quebec (Canada)). pp. 7 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

An infinite set of symmetry transformations for the 2-dimensional SU(n) σ model with a Wess-Zumino term is presented. The algebraic structure spanned by these symmetries is studied. The left and right symmetries are shown to decouple at the critical values of the ratio of the coupling constants.

35370 Relationship between supersymmetry and solvable potentials. Cooper, F. (Los Alamos National Lab., NM (USA)); Ginocchio, J.N.; Khare, A. pp. 7 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

The authors study in detail the relationship between the general class of solvable Natanzon potentials, supersymmetry and shape invariance. They first show that this general class of solvable potentials can be cast into supersymmetric form. They then show that these solvable potentials are not in general shape invariant; i.e. shape invariance even though sufficient is not a necessary condition for exact solvability. Further, using supersymmetry they generate a huge class of new solvable potentials which do not belong to the Natanzon class.

35371 Effective quark-diquarksupersymmetry and the splitting of the Regge trajectories. Catto, S. (Baruch College of the City Univ. of New York, NY (USA)); Kuyucak, S. pp. 6 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

Splitting of Regge trajectories and their deviations from their linear limit for smaller values of the orbital angular momentum are calculated and are shown to be in excellent agreement with recent experimental results. Also, following the suggestion of a linear confinement potential for the quarks inside hadrons from lattice QCD, the authors solve numerically the Dirac equation for the case of a scalar potential V_s = cr. They evaluate the energy expectation values, and calculate the masses of hadrons.

35372 N=2 superconformal quantum harmonic oscillator. Dehin, D. (Universite de Liege (Belgium)). pp. 6 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

The largest invariance superalgebra of the supersymmetric harmonic oscillator has been found. Here the authors consider the three-dimensional case that they compare with other recent contributions and different ways of supersymmetrization.

35373 Superspace formulation of 10-D sugra+sym theory A La Green-Schwarz. Bonora, L. (Univ. of Padova (Italy)); Pasti, P.; Tonin, M. pp. 6 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

The authors have developed a superspace formulation for the coupling of supergravity and supersymmetric Yang-Mills theory. The superfields relevant to the superspace formulation are the supervielbeins, the Lorentz superconnection, Lie-algebras, the Lorentz curvature, the gauge curvature and needed superforms.

35374 Parastring theories. Mansouri, F. (Univ. of Cincinnati, OH (USA)). pp. 6 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

Parastring theories are formulated in the light cone gauge, and their properties are discussed.

35375 Q_{BRST} and negative norm states: an application to the bosonic string. Spiegelglas, M. (School for Natural Sciences, Princeton, NJ (USA)). pp. 8 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

Studying the relationship between a BRST operator, satisfying $Q\dagger = Q$, $Q^2 = 0$ and the negative metric space on which it acts, conditions for the cohomology of Q to be positive definite are formulated. An application to the Bosonic String and gives a new proof and some insight into the No - ghost theorem.

35376 Orthonormal gauge and affine geometry in string theory. Cho, B.H. (Korea Advanced Institute of Science and Technology, Seoul); Myung, Y.S. pp. 4 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

The authors discuss orthonormal gauge, affine transformation and conformal transformation in string theory.

35377 Non-compact symmetric spaces in current particle theories. Ha, Y.K. (Temple Univ., Philadelphia, PA (USA)). pp. 3 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

A survey of the recent physical uses of non-compact homogeneous manifolds G/H, where G is a non-compact Lie group and H its maximal compact subgroup, is given in the context of supergravity models and high-dimensional theories. Dynamical considerations involved in the study of theories with global non-compact symmetries are outlined.

35378 Superinvariant chiral fields. Panagopoulos, H. (Universita di Pisa (Italy)); Vinet, L. pp. 8 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

The characterization of chiral fields with conformal supersymmetries is summarized.

35379 Bag formation in a chiral model. Jain, P. (Syracuse Univ., NY (USA)). pp. 10 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

The low energy properties of the nucleon can be qualitatively explained either by considering it as a soliton (Skyrmion) in a theory of mesons or by considering it as a composite state of three quarks trapped in a bag (bubble) in the QCD vacuum. One would like to inquire as to the analog of the vacuum bubble in the chiral model of mesons. Here they discuss a simple extension of the Skyrme model in which a vacuum bubble may be automatically generated for the nucleon. Their toy model is constructed with an additional gluonic background field in such a way that the trace anomaly of QCD is satisfied. Although the model is certainly a rough approximation to the true low energy effective Lagrangian it does have the nice feature of giving a similar fit to the nucleon parameters as the original Skyrme model, using however the experimental value of the pion decay constant.

35380 Derivation of Dirac's bispinor equation from a Yang-Mills Lagrangian. Morris, R. (RCA/MSR, Morrestown, NJ (USA)); Reifler, F. pp. 4 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

The Dirac bispinor equation can be derived from a Yang-Mills Lagrangian in the limit of a large coupling constant, and all observables associated with the Dirac bispinor field may be directly expressed using Yang-Mills formulas. The tensor formula obtained this way for the Dirac Lagrangian agrees with the formula recently derived by Takahashi and Zhelnorovich.

35381 Nonholonomic systems with symmetry (and a model for a classical particle on a Yang-Mills field). Koiller, J. (Instituto de Matematica de UFRJ, Rio de Janeiro (Brazil)). pp. 4 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

The author presents the reduced equations for two types of nonholonomic systems with Lie group symmetry. One of them leads to a model for the motion of a particle in a gauge field.

35382 3-cocycles in the monopole sector of gauge theories. Bakas, I. (Univ. of Texas, Austin (USA)); McMullan, D. pp. 6 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

Using the Chern-Simons secondary characteristic class, a generalized descent tower of globally defined cocycles results. The authors study its relevance to monopole physics when the defining simplexes interpolate between disconnected components of the gauge group orbit in the space of Yang-Mills connections. They focus their attention to 1 and 3 such cocycles of the 3-space gauge group.

35383 Polynomial link invariant, braid groups and the XXZ chain. Carr, R.R. (Drexel Univ., Philadelphia, PA (USA)). pp. 8 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

Recently, a number of new and powerful polynomial invariants have been discovered for tame oriented links in 3-space. In this note, they describe a simple link invariant closely related to the XXZ quantum spin chain.

35384 Spin(8) representations and particle physics. Smith, F.D. Jr. (Georgia Institute of Technology, Atlanta (USA)). pp. 6 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

The half-spinor, adjoint, and vector representations of Spin(8) are interpreted as corresponding respectively to fermion leptons and quarks, to gauge bosons, and to a base manifold that reduces by a geometric Higgs mechanism to a 4-dimensional space-time. The geometry of the resulting Spin(8) gauge field theory gives values for elementary particle masses and force strength constants that are roughly consistent with experimental results insofar as they exist, and predictions of values that can be tested experimentally in the near future, such as prediction of the t-quark mass to be about 130 Gev.

35385 Different symmetries of mesons and baryons. Bhattacharjee, B.J. (Saint Anthony's College, Shillong (India)). pp. 4 of

Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

It is observed that properties of elementary particles (eps) are periodic function of rest mass/energy. Symmetries arises out of Energy-spin term diagram (and parity - spacing rule conditions) shows that numerically many GMO formulae exist. It also indicates how many particles may exist in nature.

35386 Announcement: the solution for the measurement problem in quantum mechanics. Yoshimura, J. (State Univ. of New York, Syracuse (USA)). pp. 6 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

The solution for the measurement problem in quantum mechanics is announced. A quantum probability space is the human information about the properties of elementary particles. It can be equal to the maximal information about the particles at the macro level universe. It is not the complete or incomplete state function of particles, but an inference function for the result of measurement. This theory rejects both the hidden variables and the measurement processes, as opposed to the traditional two major interpretations of probability in quantum mechanics.

35387 Isotropy subgroups for reducible representations of space groups. Hatch, D.M. (Brigham Young Univ., Provo, UT (USA)); Stokes, H.T. pp. 6 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

A procedure is outlined which yields the isotropy subgroups (of a given space group G_0) allowed by reducible representations. The method uses the isotropy subgroups obtained for irreducible representations. Subgroups associated with the direct sum of two irreducible representations are obtained by group intersection. The resulting subgroups correspond physically to the lower symmetry phases for coupled order parameters. An example is given where D_{4h}^1 is taken as G_0.

35388 Space groups with Q-reducible point groups. Kopsky, V. (Pennsylvania State Univ., Reading (USA)); Litvin, D.B. pp. 6 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

If a point group G of a space group G is Q-reducible, then the group G has the following properties: (1) The point group G is a direct or subdirect product of point groups H_1 and H_2 which act on G-invariant subspaces V_1 and V_2. (2) The translation subgroup T_G splits into a direct or subdirect product of its projections T_1 and T_2 onto V_1 and V_2. (3) The subgroups $T_1^\circ = T_G \cap V_1$ and $T_2^\circ = T_G \cap V_2$ are normal in G and the corresponding factor groups G/T_1° and G/T_2° have the structure of subperiodic groups. (4) The group G itself is a direct or subdirect product of space groups of lower dimensions. These properties can be used either for the analysis of space groups with Q-reducible point groups or for the construction of space groups on the basis of the knowledge of lower dimensional ones. These points are illustrated by an example of groups of Laue Class D_4.

35389 Physical applications of compatibility relations for space group Clebsch-Gordan coefficients. Dirl, R. (Technische Universitat Wien (Austria)). pp. 6 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

Compatibility relations for multiplicities and for space group Clebsch-Gordan matrices are presented for the first time. Closed expressions are derived in both cases. The implications of continuous parameter variations are analyzed in terms of a special class of irreducible tensor operators.

35390 Various classification schemes for irreducible space group representations. Davies, B.L. (Univ. of Wales, Bangor (England)); Dirl, R. pp. 6 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

Various classification schemes for space group irreps are discussed. The various schemes are either due to different shapes of representation domains or due to chain adaptations. The authors also propose a unification procedure to standardize space group irreps.

35391 Auxiliary group approach to the reduction of multiple Kronecker products and to chain-adapted reducing matrices. Aroyo, M.I. (Univ. of Sofia (Bulgaria)); Kotzev, J.N.; Dirl, R.; Kasperkovitz, P.; Davies, B.L. pp. 5 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

The auxiliary group approach (AGA) utilizes a set of transformations of (co)representations to derive relations between the elements of a matrix that decomposes a reducible (co)rep of a given group into irreducible constituents. The method reduces the number of matrix elements that have to be calculated and establishes conventions for multiply occurring (co)irreps. In this note AGA is applied to multiple Kronecker products and combined with well-known group-subgroup relations.

35392 6D-symbols for corepresentations of antiunitary magnetic groups. Angelova, M.N. (Univ. of Sofia (Bulgaria)); Peev, M.K.; Aroyo, M.I.; Kotzev, J.N. pp. 6 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

The discussed symmetry and generating relations for 6D-symbols are common for the cases of reps and coreps. The peculiarities of the corep Schur lemma and of the coreps themselves lead to some essential differences in the two cases. Besides, those properties of the 6j-symbols, that are connected with the orthogonality relations for 3j-symbols (such as Biedenharn identity, Racah backcoupling rule) are in doubt for the above defined 6D-symbols (2). The symmetry and generating relations for 6D-symbols are extensively applied in their calculation. They effect in decreasing the volume of the necessary calculations and moreover they open the possibility for obtaining a set of 6D-symbols, whose properties mimic to a great extent those of the 6j-symbols. They have calculated and tabulated the sets of 6D-symbols for all single and double-valued coreps of the eleven gray and black-and-white cubic point groups. The results will be published elsewhere.

35393 GRAPE - Group representation and application in physics environment. Zhan, C. (Institute of Theoretical Physics, Beijing (China)); Jun-ming, G.; Bai-lin, H. pp. 5 of Group theoretical methods in physics. Gilmore, R. (ed.) World Scientific Publishing Company Pte. Ltd., Singapore (1987). (CONF-8610110–: 15. international colloquium on group theoretical methods in physics, Philadelphia, Pennsylvania, USA, 20-24 Oct 1986).

The authors describe a knowledge-engineering project to build a Group Representation and Application in Physics Environment, abbreviated as GRAPE. For the time being, it includes some knowledge of point groups and space groups, as well as a few applications to physical problems. The architecture of GRAPE is hierarchical and modular. A natural language interface has been provided. A model of GRAPE has been implemented and tested. It is written in LISP. They aim at providing a powerful group-theoretical environment for physicists in the future.

35394 Quantum level statistics of pseudointegrable billiards. Cheon, T. (Department of Physics and Astronomy, University of

Maryland, College Park, Maryland 20742(US)); Cohen, T. D. *Physical Review Letters (USA)*, 62(24): 2769-2772 (12 Jun 1989).

We study the spectral statistics of systems of two-dimensional pseudointegrable billiards. These systems are classically nonergodic, but nonseparable. It is found that such systems possess quantum spectra which are closely simulated by the Gaussian orthogonal ensemble. We discuss the implications of these results on the conjectured relation between classical chaos and quantum level statistics. We emphasize the importance of the semiclassical nature of any such relation.

70 FUSION ENERGY

35395 (UCID–21706) **Current benefits of fusion energy research.** Glass, A.J. Lawrence Livermore National Lab., CA (USA). 10 Mar 1989. 14p. Sponsored by DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE89013384/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This paper contains the text of an address given to staff members of several congressional committees on the present benefits of fusion energy research. This talk gives a nontechnical overview of fusion energy now and in the future.

7001 Plasma Research

Refer also to citation(s) 34293, 34891, 34892, 35204, 35449

35396 (ACIESP–60(v.3), pp. 320-330) **Critical power for rf current drive.** Assis, A.S. de (Universidade Estadual de Campinas, SP (Brazil). Inst. de Fisica); Busnardo Neto, J. Academia de Ciencias do Estado de Sao Paulo, SP (Brazil). 1988. (CONF-8808156–: 6. Japan-Brazil symposium on science and technology, Sao Paulo, Brazil, 10-12 Aug 1988). In *Proceedings of the 6. Japan-Brazil Symposium on Science and Technology.* Order Number DE89612371/JAW. Available from NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS.

A one dimensonal quasilinear formulation is used to study RF current generation with low-frequency Alfven waves in a uniform, infinite plasma. Three regimes are identified: 1- weak source, in which the current is proportional to the applied power; 2- strong-source, in which a plateau exists in the distribution function and the current saturates; 3- Critical-source, an intermediary situation where the minimum power needed for current saturation can be estimated. Values of this critical power and the saturation current for the kinetic Alfven wave used as a driver in several contemporary tokamaks are presented.

35397 (ACIESP–60(v.3), pp. 331-339) **Quasilinear electron cyclotron absorption in a slab model for TBR-2.** Ziebell, L.F. (Rio Grande do Sul Univ., Porto Alegre (Brazil). Inst. de Fisica). Academia de Ciencias do Estado de Sao Paulo, SP (Brazil). 1988. (CONF-8808156–: 6. Japan-Brazil symposium on science and technology, Sao Paulo, Brazil, 10-12 Aug 1988). In *Proceedings of the 6. Japan-Brazil Symposium on Science and Technology.* Order Number DE89612371/JAW. Available from NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS.

The electron cyclotron radiation generated by a gyrotron of operating frequency f = 35 GHz and power of 60 kW is used for heating and current drive experiments in the tokamak TBR-2 a project currently under study. A quasilinear code, that contains a self-consistent diffusion coefficient for electron cyclotron waves, averaged over tokamak magnetic surfaces, and includes collisions by means of a linearized Fokker-Planck collison term was developed. This code is applied to a slab model for TBR-2, supposed with an initial current presenting features of lower hybrid generated currents. A numerical analysis of two situations with good absorption is done.

35398 (ACIESP–60(v.3), pp. 340-347) **RFP plasma experiment at INPE.** Ueda, M. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos, SP (Brazil)); Aso, Y. Academia de Ciencias do Estado de Sao Paulo, SP (Brazil). 1988. (CONF-8808156–: 6. Japan-Brazil symposium on science and technology, Sao Paulo, Brazil, 10-12 Aug 1988). In *Proceedings of the 6. Japan-Brazil Symposium on Science and Technology.* Order Number DE89612371/JAW. Available from NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS.

Plasma experiments in CECI, a small Reversed Field Pinch (RFP) apparatus, are described. Preliminary measurements in this device shown the production of a plasma with peak current of 1.3kA and discharge duration of nearly 80μs, when a toroidal DC field of 100G was used. A loop voltage of 40V was measured and a maximum electron temperature of 3eV was estimated for these discharges. Experimental points in the F-θ diagram for CECI indicate that its plasma is approaching the RFP configuration when the discharge is optimize. The probe data also show that the plasma column expands outward. Numerical results indicate that leakage fields have to be reduced below 5G to form appropriate magnetic surfaces.

35399 (ACIESP–60(v.3), pp. 367-376) **Non-stationary classical diffusion in field - reversed configurations.** Clemente, R.A. (Universidade Estadual de Campinas, SP (Brazil). Inst. de Fisica); Sakanaka, P.H.; Mania, A.J. Academia de Ciencias do Estado de Sao Paulo, SP (Brazil). 1988. (CONF-8808156–: 6. Japan-Brazil symposium on science and technology, Sao Paulo, Brazil, 10-12 Aug 1988). In *Proceedings of the 6. Japan-Brazil Symposium on Science and Technology.* Order Number DE89612371/JAW. Available from NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS.

Plasma decay in field-reversed configurations (FRC) is described using resistive MHD equations. Assuming non-stationariety together with uniform but time dependent plasma temperature and neglecting inertial effects in the momentum balance equation, it is possible to show that the functional dependence of the plasma pressure with the poloidal magnetic flux remains fixed during diffusion. This allows to describe FRC evolution as a continuous sequence of plasma equilibria satisfying proper boundary conditions. The method is applied to pressure profiles linear with the poloidal magnetic flux obtaining the evolution of the flux, the number of confined particles and the size of the plasma boundary.

35400 (ACIESP–60(v.3), pp. 348-358) **Recent results in T.C. - I UNICAMP.** Machida, M. (Universidade Estadual de Campinas, SP (Brazil)); Aramaki, E.A.; Porto, P.; Berni, L.A.; Sakanaka, P.H.; Ueda, M.; Aso, Y. Academia de Ciencias do Estado de Sao Paulo, SP (Brazil). 1988. (CONF-8808156–: 6. Japan-Brazil symposium on science and technology, Sao Paulo, Brazil, 10-12 Aug 1988). In *Proceedings of the 6. Japan-Brazil Symposium on Science and Technology.* Order Number DE89612371/JAW. Available from NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS.

Recent results obtained in the implosion phase of the field reversed theta-pinch T.C.-I operating at UNICAMP are present. The diagnostics involved in this phase are: internal and external probes, Rogowski loops, Faraday Cup, photodiode and spectrometer measurements. The main results from these diagnostics are: total current on solenoid coils for 20 kV discharge, 150 kA; maximum magnetic field, 3 kG; end scape speed, 3 x 10^6 cm/s; scape beam density, 2,6 x 10^{12} cm $^{-3}$; estimated ion temperature at the center $\simeq$ 150 eV; line density from MHD oscillations, $\simeq$ 2 x 10^{15} cm^{-3}.

35401 (ACIESP–60(v.3), pp. 307-313) **Sawteeth fluctuations detection.** Vannucci, A. (Sao Paulo Univ., SP (Brazil). Inst. de Fisica); Nascimento, I.C. do; Caldas, I.L.; Sanada, E.K.; Tuszel, A.G.; Fagundes, A.N. Academia de Ciencias do Estado de Sao Paulo, SP (Brazil). 1988. (CONF-8808156–: 6. Japan-Brazil symposium on science and technology, Sao Paulo, Brazil, 10-12 Aug 1988). In *Proceedings of the 6. Japan-Brazil Symposium on Science and Technology.* Order Number DE89612371/JAW. Available from NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS.

Sawteeth oscillations were identified during the discharges in the small Tokamak TBR-1 through a pin-hole camera and their main characteristics were studied. Comparing the measured period of the internal disruption (sawteeth) with the ones expected from scaling laws, good agreement is reached. The measured sawteeth crashes agree with the value expected from Kadomtsev's model. However, there some sawteeth oscillations, corresponding to conditions of higher Z_{eff} of the plasma, which showed longer crashes that could not be explained by this model.

35402 (ACIESP–60(v.3), pp. 359-366) **Rotational instabilities in field reversed configurations.** Santiago, M.A.M. (Universidade Federal Fluminense, Niteroi, RJ (Brazil)); Tsui, K.H.; Ponciano,

B.M.B.; Sakanaka, P.H. Academia de Ciencias do Estado de Sao Paulo, SP (Brazil). 1988. (CONF-8808156–: 6. Japan-Brazil symposium on science and technology, Sao Paulo, Brazil, 10-12 Aug 1988). In *Proceedings of the 6. Japan-Brazil Symposium on Science and Technology*. Order Number DE89612371/JAW. Available from NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS.

The rotational instability (n = 2 toroidal mode) in field reversed configurations (FRC) using the ideal MHD equations in cylindrical geometry is studied. These equations are solved using a realistic densite profile, and the influence of some plasma parameters on the growth rate is analysed. The model shows good qualitative results. The growth rate increases rapidly as rotational frequency goes up and the mode m = 2 dominates over the m = 1 mode. With the variation of the density profile, it is observed that the growth rate decreases as the density dip at the center fills up. Calculated value ranges from 1/2 to 1/7 of the rotational frequency Ω whereas the measured value is around $\Omega/50$. The developed analysis is valid for larger machines. The influence of the plasma resistivity on the mode stabilization is also analysed. The resistivity, which is the fundamental factor in the formation of compact torus, tends to decrease the growth rate.

35403 (CEA-R–5477) **Theory of plasma electrodynamics.** Bonnaud, G. CEA Centre d'Etudes de Limeil, 94 - Villeneuve-Saint-Georges (France). 1989. 208p. (In French). Order Number DE89781577/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

The subject of this report is the physics of the electromagnetic behaviour of unmagnetized plasmas. After basic kinetic concepts, the dispersion relation of the plasma modes are developed, with emphasis on the comparison between the analytical expressions and the exact numerical solutions, especially on Landau dampings. Then, collisional dampings are presented. The mode couplings which drive parametric instabilities are then treated. Finally, the non-linear mechanisms, the pump depletion, designed as weak non-linearity, and the strong non-linearities which affect the longitudinal modes are discussed.

35404 (CONF-8905120–16) **Fast wave current drive modeling for ITER and prospects for a near-term proof of principle experiment.** Batchelor, D.B.; Jaeger, E.F.; Carter, M.D.; Swain, D.W. Oak Ridge National Lab., TN (USA). 1989. 5p. Sponsored by DOE Energy Research. DOE Contract AC05-84OR21400. From 8. topical conference on radio frequency power in plasmas; Irvine, California, USA; 1-3 May 1989. Order Number DE89013049/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

It is widely recognized that a key element in the development of an attractive tokamak reactor, and in the successful achievement of the mission of ITER is the development of an efficient steady state current drive technique. The two primary issues to be resolved are: Can an acceptable antenna be designed to produce a $k_{\|}$ spectrum with most power in the phase velocity range $v_e < v_{phase} < c$? Will the rf power be efficiently absorbed by electrons in the desired velocity range without unacceptable parasitic damping by fuel ions and α particles? To address these issues we have employed the ORION code which gives a 3D full-wave solution of the fast wave equations in tokamak geometry along with power absorption and current drive profiles. This 3D code realistically models the launched antenna spectrum with radial focusing, includes toroidal eigenmode effects (multiple pass absorption) if present, and includes the effects of ion cyclotron harmonic and α particle damping. 8 refs., 1 fig.

35405 (CONF-8905120–17) **Loading, absorption, and Fokker-Planck calculations for upcoming ICRF experiments on ATF.** Shepard, T.D.; Carter, M.D.; Goulding, R.H.; Kwon, M. Oak Ridge National Lab., TN (USA). 1989. 5p. Sponsored by DOE Energy Research. DOE Contract AC05-84OR21400. From 8. topical conference on radio frequency power in plasmas; Irvine, California, USA; 1-3 May 1989. Order Number DE89013059/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

ICRF experiments on ATF at the 100-kW level are planned for the current 1989 operating period. These plans include the $2\omega_{cH}$ regime at f_{RF} = 28.88 MHz, D(H) at 14.44 MHz, and ^{4}He(^{3}He) and D(^{3}He) at 9.63 MHz. ECH target plasmas have $n_{eo} \lesssim 0.15 \times 10^{20}$ m^{-3} and B = 0.95 T. The density and temperature profiles obtained are broader than those from 1988, owing to recent field error corrections. The values used for target-plasma parameters in the calculations were taken from initial 1989 ATF data. Loading and absorption calculations have been performed using the 3D RF heating code ORION with a helically symmetric equilibrium, and Fokker-Planck calculations were performed using the steady-state code RFTRANS with two velocity dimensions and one spatial dimension. 6 refs., 3 figs.

35406 (CRN-CPR–88-05) **Spectral density analysis of noisy repetitive pulses. Models for continuously operating mode-locked lasers.** Cunin, B.; Geoffroy, B.; Heisel, F.; Lepine, T.; Miehe, J.A. Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires. 1988. 29p. Order Number DE89781552/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

A theoretical description and the interpretation of the power spectra of high repetition rate laser pulses showing fluctuations in time, intensity and shape are presented.

35407 (DOE/ER/53175–T1) **[Collision processes of interest in MFE plasma research]: Progress report.** Missouri Univ., Rolla, MO (USA). [1989]. 3p. Sponsored by DOE Energy Research. DOE Contract FG02-84ER53175. Order Number DE89013681/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Research on this grant is devoted to the calculation of heavy particle collision cross sections needed for diagnostics studies of magnetic fusion plasmas. This work requires the development and testing of new theoretical techniques, and the implementation of benchmarked methods to collisions pertinent to fusion reactors. On the last context, we have provided the cross sections for modeling the beam penetration in an ERT plasma, charge exchange recombination values for impurity ion diagnostic studies, and those for assessing the feasibility of using a high efficiency plasma neutralizer for 0.5 to 1.0 MeV/u D^- beams. We have also extended our theoretical understanding to H^+, He^{++} + He collisions in order to be prepared for the modeling of helium and transport in the next generation of reactors.

35408 (DOE/ER/53227–134) **Magnetic turbulence versus safety factor in the Tokapole II tokamak.** Graessle, D.E. Wisconsin Univ., Madison, WI (USA). Plasma Physics Research. 1989. 143p. Sponsored by DOE Energy Research. DOE Contract FG02-86ER53227. Order Number DE89012875/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

Low-frequency ($\omega \ll \omega_{ci}$) radial magnetic turbulence has been measured over the full radius (r = 0 – 18 cm) for discharges in Tokapole II. It has been scaled over the range of edge safety factor 0.6 {<=} q_a {<=} 5.0. It was found that q_a served as a control parameter for both the magnetic fluctuation amplitude and the global confinement time. As q_a is reduced from 5 to 0.6 the turbulence level increases by a factor of fifty while the confinement time decreases by more than a factor of ten. Due to the lack of profile diagnostics, no detailed study of confinement could be done. The turbulent amplitude 1 cm inside the separatrix is nearly large enough for q_a {<=} 1 to account for the global confinement by means of collisionless stochastic magnetic transport. Frequency spectra have been obtained reliably from 10 to 400 kHz. For all q_a most of the fluctuation power appears below 100 kHz. This low-frequency structure changes as the safety factor is varied. Although the spectra do not always have clearly-defined peaks in this range of f, radial coherence lengths at these frequencies are very long, indicating global modes with a broadband structure. For f {>=} 100 kHz, the spectra become featureless, with a power-law frequency decay. For q_a {<=} 3, the spectra decay as $f^{-1.4}$ in all cases. For higher q_a, a new power law decay of $f^{-2.3}$ appears. Radial, poloidal, and parallel correlation analysis has been done for the full range of q_a, but with less detailed scan than was included in the amplitude studies.

35409 (DOE/ET/51013–263) **Testing of full scale ITER OHMIC heating coil conductors.** Hoenig, M.O. Massachusetts Inst. of Tech., Cambridge, MA (USA). Plasma Fusion Center. Jan 1989. 32p. Sponsored by DOE Energy Research. DOE Contract AC02-78ET51013. Order Number DE89014650/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The optimized conductor, "CICC-OH-1" is designed for 12.5 T operation at 30 kA with an I(op) /I(crit) ratio [R_I] of 0.5, with B_{max} =

14.7 T at R_I = 1.0. To use "CICC-OH-1" in the 2.5 m bore OH Coil, the CIC is co-wound with a structural band, sized to limit tensile strength to 50% of Yield at 30 kA and 12.5 T. When wound into a 1.3 m bore test coil, tensile stress in the "CICC-OH-1" conduit equals 50% of Yield at 30 kA and 12.5 T. The conductor requires no additional inter-turn structure in this coil configuration. Conduit thickness of the "CICC-OH-1" permits a minimum bend radius of 0.5 m. A 1.3 m bore test coil could be economically produced by upgrading the JAERI DPCF Test Facility. The DPCF increase in field would be achieved by the replacement of its 30 kA NbTi DPC-U1 & U2 field coils with coils using new 30 kA Nb_3Sn conductor. The upgraded DPCF Coil would consist of three or four 1.3 m bore pairs of coil modules. Conductor used would be "CICC-OH-1" or equivalent. Three or four full scale candidate OH Coil conductors, provided by different sponsors could thus be readily evaluated as part of the upgraded DPC Facility. The proposed test coil could also accommodate test pancakes or modules of other conductors. We believe that an upgrade of the existing DPCF facility, with an investment of $M 20 in a new 3-Module-Pair Coil, is feasible. The investment could logically be shared by three and four sponsors. The upgrade would also have to include modifications to the DPCF Cryogenic system to accommodate higher AC loss. 12 figs., 2 tabs.

35410 (GA-A–19667) **Electron cyclotron emission spectra calculated from ECRF heated electron distributions obtained with a 3D Fokker-Planck code.** Harvey, R.W.; O'Brien, M.R.; McCoy, M.G.; Kerbel, G.D. General Atomics, San Diego, CA (USA). May 1989. 12p. Sponsored by DOE Energy Research. DOE Contract AC03-89ER53277. (CONF-8905159–1: Joint IAEA technical committee meeting on ECE and ECRH and 7th joint workshop on ECE and ECRH (EC-7), Hefei, China, 8-11 May 1989). Order Number DE89013026/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Cyclotron emission spectra are obtained with a new computer code HORACE which incorporates ray tracing and a relativistic determination of the absorption and emission coefficients from nonthermal electron distributions. The latter are obtained from a 3D bounce-averaged Fokker-Planck code. Ohmic and ECH heated discharges from DIII-D, T-10, and FT-1 are examined to evaluate the extent that ECE measurements represent average plasma energies, and to interpret nonthermal ECE features. 13 refs., 4 figs.

35411 (HIFT–144) **Macroscale implicit electromagnetic particle simulation of magnetized plasmas.** Tanaka, Motohiko. Hiroshima Univ. (Japan). Inst. for Fusion Theory. Jan 1988. 39p. Order Number DE89778170/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

An electromagnetic and multi-dimensional macroscale particle simulation code (MACROS) is presented which enables us to make a large time and spatial scale kinetic simulation of magnetized plasmas. Particle ions, finite mass electrons with the guiding-center approximation and a complete set of Maxwell equations are employed. Implicit field-particle coupled equations are derived in which a time-decentered (slightly backward) finite differential scheme is used to achieve stability for large time and spatial scales. It is shown analytically that the present simulation scheme suppresses high frequency electromagnetic waves and that it accurately reproduces low frequency waves in the plasma. These properties are verified by numerical examination of eigenmodes in a 2-D thermal equilibrium plasma and by that of the kinetic Alfven wave.

35412 (HIFT–146) **Development of stochastic webs in a wave-driven linear oscillator.** Murakami, Sadayoshi; Sato, Tetsuya; Hasegawa, Akira. Hiroshima Univ. (Japan). Inst. for Fusion Theory. Jan 1988. 27p. Order Number DE89778171/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

We present developments of stochastic webs in a linear oscillator which is driven by a finite number (N) of external waves with frequency ω_0 (harmonic of the linear oscillator frequency). The expansion of the stochastic domain as functions of the number of waves and their amplitudes is studied numerically. The results with small amplitude waves compares well with the perturbation theory. When the amplitude of external waves is small a leaf structure which expands with N develops radially in the phase space.

35413 (HIFT–148) **Effects of an ambipolar field on stability of electrostatic drift waves in sheet plasmas.** Chaudhry, M.B.; Nishikawa, Kyoji; Hojo, Hitoshi; Watanabe, Tsuguhiro. Hiroshima Univ. (Japan). Inst. for Fusion Theory. May 1988. 28p. Order Number DE89778172/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The effects of an ambipolar field on stability of electrostatic drift waves in sheet plasmas are investigated numerically. The analysis is based on an integral equation in the wavenumber space derived from the profiles of Gaussian density and parabolic ambipolar potential. The ambipolar field dependence of the eigenfrequency and eigenfunction of the drift waves is obtained. It is found that the drift waves are stabilized for a strong ambipolar potential of both the hill-type and well-type. The stabilization is due to the ion Landau damping caused from the velocity shear effect of the ExB drift. Purely growing (zero real frequency) drift modes are also found in the case of a hill-type ambipolar potential.

35414 (IAE–4545/15) **TRANSITOR computer code for calculation and analysis of transport processes in a tokamak.** Pereverzev, G.V.; Yushmanov, P.N. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Atomnoj Ehnergii. 1987. 33p. (In Russian). Order Number DE89617633/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A program complex designed for analysis of transport processs in a tokamak is described. The given system differs from the programs which are currently used by the fact that the user can do without programming languages. Transport phenomena are written in the form maximally closed to the form of equation writting in articles. To record transport coefficients, various elementary and other processes one can use library formulas describing a wide set of physical processes. Creation of a program of numeric solution on the base of assigned equations of analysis or calculation of transport processes is realized in TRANSITOR system automatically.

35415 (IC–88/384) **Producing of an ECR plasma using 2450MHz Whistler Wave and the investigating of its parameters.** Fang Yude; Zhang Jiande; Fu Keming; Lu Xiangyu; Liu Dengcheng; Wang Xianyu; Xie Weidong; Bao Dinghua; Yin Xiejin. International Centre for Theoretical Physics, Trieste (Italy). Dec 1988. 16p. Order Number DE89618689/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A stable ECR plasma was produced and sustained in HER mirror using 2450MHz Whistler wave. The parameters of the ECR plasma and their chaining characters were studied in detail and were compared with those of the DC discharge plasmas. The conclusion is that the ECR plasma is a high ionizability, low temperature, middle density plasma, its peak density may much exceed the cutoff density of the pump wave (when $\omega = \omega_{pe}$) and arrive at the order of $10^{12}cm^{-3}$. The ECR plasma includes some high energy hot electrons (20Kev-200Kev) and middle energy warm electrons (< 20Kev). Those two kinds of electron created some strong X-ray emissions in a wide frequency range. The ECR plasma has higher edge density and can strongly interact with the wall. (author). 9 refs, 17 figs.

35416 (IC–89/15) **Effects of the wave-driven radial motion in lower-hybrid current drive tokamak.** Wu Weimin; Xia Mengfen. International Centre for Theoretical Physics, Trieste (Italy). Jan 1989. 13p. Order Number DE89617674/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

It is pointed out that there is a remarkable effect of wave-driven motion on the relaxation process, the stationary state, the wave-particle coupling mechanism and the wave-driven radial transport for the strong-wave case in lower-hybrid current drive tokamak. (author). 12 refs.

35417 (INIS-mf–11443) **Wills Plasma Physics Department annual progress report 1987.** Sydney Univ. (Australia). Dept. of Plasma Physics. 1988. 40p. Order Number DE89617632/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The experimental research program has three major themes - the study of hydromagnetic waves and RF heating using the TORTUS tokamak, the development of diagnostic techniques particularly those based on submillimetre lasers and the gyrotron, and gas discharge studies.

35418 (IPPJ–867) **Proceedings of the US-Japan workshop on advanced plasma modeling, 3.** Nagoya Univ. (Japan). Inst. of Plasma Physics. Apr 1988. 51p. (CONF-8703311–: 2. U.S.-Japan workshop on advanced plasma modeling, Nagoya, Japan, 23-27 Mar 1987). Available from NTIS (US Sales Only), PC A03/MF A01.

Individual papers are processed separately for the data base. (DLC)

35419 (IPPJ–867, pp. 1-23) **Vlasov ion zero mass electron model for plasma simulations.** Dawson, J.M. (California Univ., Los Angeles (USA)); Kazeminezhad, F. Nagoya Univ. (Japan). Inst. of Plasma Physics. Apr 1988. (CONF-8703311–: 2. U.S.-Japan workshop on advanced plasma modeling, Nagoya, Japan, 23-27 Mar 1987). In *Proceedings of the US-Japan workshop on advanced plasma modeling, 3.* Order Number DE89012145/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

We have developed two-and three-dimensional models with kinetic ions and massless fluid electrons. The use of fluid electrons allows us to eliminate the electric field so that it never has to be solved for. We are then able to derive a Vlasov equation for the particle ions and obtain the linear dispersion relation from it. We compare the results from this theory with simulation results from our model; excellent agreement is found. The model exhibits Alfven waves, ion cyclotron waves, low frequency whistler waves and ion Bernstein waves. We have used the model to simulate instabilities such as might be caused by the injection of an energetic neutral beam into the plasma. We have also implemented a two time step correction technique into code which improves energy conservation by a factor of 10^3 and allows us to use time steps which are an order of magnitude larger. (J.P.N.).

35420 (IPPJ–867, pp. 24-48) **Modeling of subtle kinetic processes in plasma simulation.** Sydora, R.D. (California Univ., Los Angeles (USA)); Decyk, V.K.; Dawson, J.M. Nagoya Univ. (Japan). Inst. of Plasma Physics. Apr 1988. (CONF-8703311–: 2. U.S.-Japan workshop on advanced plasma modeling, Nagoya, Japan, 23-27 Mar 1987). In *Proceedings of the US-Japan workshop on advanced plasma modeling, 3.* Order Number DE89012145/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

A new diagnostic method for plasma simulation models is presented which enables one to probe the subtle dielectric properties of the plasma medium. The procedure involves the removal of the background plasma response in order to isolate the effects of small perturbing influences which are externally added. We have found the technique accurately describes fundamental kinetic plasma behavior such as the shielding of individual test charges and currents. Wave emission studies and drag of test particles has been carried out in explicit particle algorithms as well as large time step implicit and gyrokinetic models. Accurate plasma behavior is produced and it is possible to investigate in detail, processes which can be compared with plasma kinetic theory. The technique of subtraction is not only limited to particle simulation models but also can be used in MHD or fluid models where resolution is difficult due to the intensity of the background response relative to the phenomena one is interested in measuring, such as a weakly grouwing instability or nonlinear mode coupling effect.

35421 (IPPT-IFTR–7/1985) **Double layers of transitional zone of multicomponent cosmic plasma.** Turski, A.J. Polska Akademia Nauk, Warsaw (Poland). Inst. Podstawowych Problemow Techniki. 1985. 37p. (In Polish). Order Number DE89618730/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

On a basis of stationary Vlasov-Poisson equation method of analysis of stationary plasma double layers and soliton waves is given. Criterion of minimalization of Landau instability and method of determination of quasistationary solutions for double layers in multicomponent plasma are presented. 13 refs., 7 figs. (M.F.-W.).

35422 (IPPT-IFTR–19/1985) **Field in a plane plasma waveguide.** Brahmer-Kacprzynska, A. Polska Akademia Nauk, Warsaw (Poland). Inst. Podstawowych Problemow Techniki. 1985. 17p. (In Polish). Order Number DE89618729/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Representation of electromagnetic field radiated from harmonic source placed in a plane waveguide filled with cold electron plasma is given. Radiation-mode and hybrid representation of this field depend on frequency of source is discussed. 7 refs., 3 figs. (L.I.).

35423 (JET-R–88-07) **Some theoretical aspects of diffusion in cylindrical plasmas.** Weenink, M.P.H. Commission of the European Communities, Abingdon (UK). JET Joint Undertaking. Sep 1988. 28p. Order Number DE89618702/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

In this preliminary report some theoretical aspects of diffusion in rotationally symmetric cylindrical plasma columns are considered. Both boundary value and initial value problems are solved in principle. Also the effect of a radially inward pinch velocity has been incorporated. The main aim was to derive rigorous solutions with which approximate solutions can be compared that have been obtained by using physically plausible assumptions. The derivations given in this report can also be used for similar problems concerning the conduction of heat.

35424 (NRC–9012959) **Pacing the US magnetic fusion program.** National Research Council, Washington, DC (USA). Committee on Magnetic Fusion in Energy Policy. 1989. 149p. Sponsored by DOE Energy Research. DOE Contract FG05-87ER54034. Order Number DE89012959/JAW. Available from NTIS, PC A08/MF A01 - OSTI; GPO Dep.

This study addresses the priority and pace of the nation's magnetic fusion research and development program in the context of long-term national energy policy. In particular, the committee interpreted its task as follows: To review the implications of long-term national energy policy for current research and development in magnetic fusion; to identify factors that should enter the further development of such policy to reduce risks associated with the future electricity supply system; to propose criteria applicable to research and develop in electric generation in reaching long-term energy policy goals; to apply these criteria to magnetic fusion and alternative electric generation technologies in order to develop recommendations on the priority pace of the magnetic fusion program; and to present its results in a final report. The most important goals of the US Department of Energy's current Magnetic Fusion Energy Program Plan are to demonstrate the scientific and engineering feasibility of fusion, Demonstrating engineering feasibility will require the design, construction, and operation of an engineering test reactor, which the plan envisions financing through a combination of domestic and international funding. The committee believes that current domestic program funding levels are inadequate to meet even the near-term objectives of the plan.

35425 (ORNL/TM–11102) **A first glance at the initial ATF experimental results.** Carreras, B.A.; Dominguez, N.; Leboeuf, J.N.; Lynch, V.E.; Charlton, L.A. Oak Ridge National Lab., TN (USA). May 1989. 34p. Sponsored by DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89013737/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

In the initial phase of ATF operation, the plasma minor radius and the edge rotational transform were reduced by field errors. This caused an effective change of the magnetic configuration: it improved the stability properties but worsened the equilibrium properties. The threshold for the second stability regime was lowered to $\beta_0 \sim 1.5\%$. Experimental profile data are compatible with operation in the second stability regime, and the achieved beta values, $\beta_0 \sim 3\%$, are well beyond the theoretically calculated threshold. Magnetic fluctuation measurements showed the effects of beta self-stabilization. They are in reasonable agreement with the predictions of the theory and support the evidence that ATF has already operated in the second stability regime. 24 refs., 20 figs., 1 tab.

35426 (PPLK–9) **Heliotron E results (1981-March 1988).** Kyoto Univ., Uji (Japan). Plasma Physics Lab. 1988. 587p. Order Number DE89778200/JAW. Available from NTIS (US Sales Only), PC A25/MF A01.

The original proposal of heliotron configuration was made by Professor Uo. The experimental studies were started in 1959 by Heliotron A, and Heliotron B (1960), Heliotron C (1965), Heliotron D (1970), Heliotron DM (1975), Heliotron E (1980) and Heliotron DR (1981) followed for more than 25 years in order to establish the proof of the principle of heliotron configuration. In this way, the heliotron has become a promising candidate for toroidal magnetic

fusion reactors. The Heliotron E results obtained in the Plasma Physics laboratory, Kyoto University, have been well accepted in the world fusion community. The data obtained in the Heliotron E are the basis for the design of a next large helical device in Japan. To commemorate the achievements of Professor Uo, the collection of all the papers concerning the Heliotron E that were published in various scientific journals from 1981 through March, 1988, including the proceedings of the European Physical Society Conference and the IAEA International Conference on Plasma Physics and Fusion Research is published. 74 papers are grouped into five categories: confinement and heating experiments, plasma-wall interaction studies, diagnostics, heating systems, and the theory related to stellarator/heliotron devices. (Kako, I.).

35427 (PPPL–2626) **Stability of elongated cross-section tokamaks to axisymmetric even poloidal mode number deformations.** Weiner, R.; Jardin, S.C.; Pomphrey, N. Princeton Univ., NJ (USA). Plasma Physics Lab. Jun 1989. 19p. Sponsored by DOE Energy Research. DOE Contract AC02-76CH03073. Order Number DE89013401/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A recent paper by Nakayama, Sato and Matsuoka suggests that elliptical cross section tokamaks with aspect ratio R/a = 3.2 and with elongation κ = 2.6 are unstable to a splitting (m = 2, n = 0) instability for plasma $\beta > 5\%$, and that κ {>=} 4.0 plasmas are unstable to splitting for β {¿ =} 1%. We have tried to reproduce these results using the MHD evolution code TSC, but find these configurations to be stable, not even near a stability boundary. Even a κ = 3.7 plasma with β = 23.0% is stable to the splitting mode. However, the addition of pinching coils at the waist will cause the plasma to split if the current in these coils exceeds a critical value I_c which decreases with increasing β. 8 refs., 11 figs., 1 tab.

35428 (TRITA-PFU–88-04) **Timedependent pinchmodel for current and temperature in Extrap.** Bonnevier, B. Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics and Fusion Research. Jun 1988. 13p. Order Number DE89617658/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A model of the build up of current and temperature of a pinch obeying the Bennet relation is presented. It is a zero-dimensional time-dependent model, employing an energy equation and assuming pressure balance. It describes the interaction of the external circuit with the toroidal plasma through the toroidal current, and estimates the driving voltage required for an Extrap pinch. Programming the discharge current may be required, so that the pinch-separatrix radius ratio is maintained within stability limits.

35429 (TRITA-PFU–88-05) **Vacuum magnetic fields in the toroidal Extrap device.** Brunsell, P.; Li Jin. Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics and Fusion Research. Aug 1988. 57p. Order Number DE89617634/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

A model of the ring system of the Extrap T1 device is developed. The model is used for calculating the distribution of poloidal flux and the vacuum magnetic field in the device. Numerical data from the model are compared with measurements. Effects of the vacuum vessel resistivity are discussed qualitatively. Measured profiles of the toroidal and the vertical bias magnetic field in the device are presented. Time constants of the vacuum vessel and the ring structure are estimated. (authors).

35430 (TRITA-PFU–88-06) **Large Debye distance effects in a homogeneous plasma.** Scheffel, J.; Lehnert, B. Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics and Fusion Research. Sep 1988. 34p. Order Number DE89617675/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The classical phenomenon of electron plasma oscillations has been investigated form new aspects. The applicability of standard normal mode analysis of plasma perturbations has been judged from comparisons with exact, numerical calculations. We consider both Maxwellian and non-Maxwellian velocity distribution. Emphasis is on perturbations for which $\alpha\lambda_D$ is of order unity, where α denotes wave number and λ_D Debye distance. The corresponding Large Debye Distance (LDD) damping is found to substantially dominate over Landau damping. This limits the validity of normal mode analysis of non-Maxwellian distributions. The physics of LDD damping and its close connection to Large Larmor Radius (LLR) damping is discussed. A major finding concerns perturbations of plasmas with non-Maxwellian, bump-in-tail, velocity distribution functions $f_0(w)$. For sufficiently large $\alpha\ \lambda_D$ (of order unity) the plasma responds by damping perturbations which are initially unstable in the Landau sense, i.e. with phase velocities initially in the interval where $df_0/dw >=0$. It is found that the plasma responds through shifting the phase velocity above the upper velocity limit of this interval. This is shown to be due to a resonance with the drifting electrons of the bump, and explains the Penrose criterion (authors).

35431 (UCRL–100574) **Pulsed lower-hybrid wave penetration in reactor plasmas.** Cohen, R.H.; Bonoli, P.T.; Porkolab, M.; Rognlien, T.D. Lawrence Livermore National Lab., CA (USA). 1989. 4p. Sponsored by DOE Energy Research. DOE Contract W-7405-ENG-48. (CONF-8905120–13: 8. topical conference on radio frequency power in plasmas, Irvine, California, USA, 1-3 May 1989). Order Number DE89013260/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Providing lower-hybrid power in short, intense (GW) pulses allows enhanced wave penetration in reactor-grade plasmas. We examine nonlinear absorption, ray propagation, and parametric instability of the intense pulses. We find that simultaneously achieving good penetration while avoiding parametric instabilities is possible, but imposes restrictions on the peak power density, pulse duration, and/or rf spot shape. In particular, power launched in narrow strips, elongated along the field direction, is desired. 4 refs., 4 figs.

35432 (UCRL–100575) **Optimum launching of electron-cyclotron power for localized current drive in a hot tokamak.** Smith, G.R. Lawrence Livermore National Lab., CA (USA). May 1989. 4p. Sponsored by DOE Energy Research. DOE Contract W-7405-ENG-48. (CONF-8905120–15: 8. topical conference on radio frequency power in plasmas, Irvine, California, USA, 1-3 May 1989). Order Number DE89012935/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Optimum launch parameters are determined for localized electron-cyclotron current drive near the magnetic axis and the q=2 surface by solving several minimization problems. For central current drive, equatorial and bottom launch are compared. Localized current drive near q=2 is studied for equatorial launch and for an alternative outside launch geometry that may be better for suppressing tearing modes and controlling disruptions. 6 refs., 2 figs.

35433 (UCRL–100591) **Modeling of LH current drive in self-consistent elongated tokamak MHD equilibria.** Blackfield, D.T.; Devoto, R.S.; Fenstermacher, M.E.; Bonoli, P.T.; Porkolab, M.; Yugo, J. Lawrence Livermore National Lab., CA (USA). 9 May 1989. 4p. Sponsored by DOE Energy Research. DOE Contract W-7405-ENG-48. (CONF-8905120–14: 8. topical conference on radio frequency power in plasmas, Irvine, California, USA, 1-3 May 1989). Order Number DE89013263/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Calculations of non-inductive current drive typically have been used with model MHD equilibria which are independently generated from an assumed toroidal current profile or from a fit to an experiment. Such a method can lead to serious errors since the driven current can dramatically alter the equilibrium and changes in the equilibrium B-fields can dramatically alter the current drive. The latter effect is quite pronounced in LH current drive where the ray trajectories are sensitive to the local values of the magnetic shear and the density gradient. In order to overcome these problems, we have modified a LH simulation code to accommodate elongated plasmas with numerically generated equilibria. The new LH module has been added to the ACCOME code which solves for current drive by neutral beams, electric fields, and bootstrap effects in a self-consistent 2-D equilibrium. We briefly describe the model in the next section and then present results of a study of LH current drive in ITER. 2 refs., 6 figs., 2 tabs.

35434 **Magnetic-field fluctuations from 0 to 26 Hz observed from a polar-orbiting satellite.** Erlandson, R.E. (Applied Physics Lab., The Johns Hopkins Univ., Johns Hopkins Road, Laurel, MD (US)); Zanetti, L.J.; Potemra, T.A. *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science (USA)*, 17(2): 196-200 (Apr 1989).

The polar orbit of the Viking satellite provides a unique opportunity to obtain observations of magnetic fluctuations at mid-altitudes on the dayside of the magnetosphere and in the polar-cusp region. One type of magnetic-field fluctuation, observed in the dayside magnetosphere, was Pc 1 waves. Pc 1 waves are in the electromagnetic ion-cyclotron mode and are generated by anisotropies in energetic ion distributions. The waves are thought to be generated near the equator and to propagate large distances along magnetic-field lines. Most observations of Pc 1 waves have been obtained near the equator using geosynchronous satellites and on the surface of the earth. The Viking observations provide an opportunity to observe Pc 1 waves at mid-latitudes above the ionosphere and to determine the spectral structure and polarization of the waves. ULF/ELF broadband noise represents a second type of magnetic fluctuation acquired by Viking. This type of magnetic fluctuation was observed at high latitudes near the polar cusp and may be useful in the identification of polar-cusp boundaries. Thirdly, electromagnetic ion-cyclotron waves have also been observed in the polar-cusp region. These waves occur only during an unusually high level of magnetic activity and appear to be generated locally.

35435 Excitation of linearly stable waves in a multispecies plasma. Roth, I. (Space Sciences Lab., Univ. of California, Berkeley, Berkeley, CA (US)); Hudson, M.K. *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science (USA),* 17(2): 201-204 (Apr 1989).

Excitation of electrostatic modes as a result of the injection of an argon beam into a multispecies plasma is investigated. It is shown that a warm beam excites waves with phase velocities in the linearly stable regime. The excitation mechanism is due to thermal fluctuations, which are enhanced by the argon beam. The importance of these modes for experimental observations and particle diffusion is discussed.

35436 The role of dust particles with large gyroradii in the 2/3 fall-down process. Azar, M.J. (Dept. of Physics, Univ. of California, San Diego, La Jolla, CA (US)); Thompson, W.B. *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science (USA),* 17(2): 228-237 (Apr 1989).

The authors consider the Alfven-Arrhenius fall-down process and propose a mechanism whereby the Rosseland electric field (the field needed to maintain quasi-neutrality) may be responsible for the capture and confinement of large gyroradius dust particles within a plasma shell stratified along the direction of the magnetic-field lines. For these particles, the effect of the magnetic force is rather weak, and they move with a constant z component of the angular momentum in a one-dimensional equivalent potential (gravitational plus centrifugal). This has a maximum at the equator and a minimum at the 2/3 points, i.e., the points where the field-aligned components of the gravitational and centrifugal forces balance. Under suitable initial conditions the authors show that these are points of maximum dust density and minimum plasma density. The authors, therefore, expect the plasma-planetisemal transition to take place at the 2/3 points in accordance with the Alfven-Arrhenius mechanism. Finally, they show that the fraction of infalling dust particles that can accrete onto the equatorial plane via the Alfven-Arrhenius and Rosseland mechanisms is rather small ($- (L/R_e) << 1$), L being the thickness of the plasma shell, and R_e, a characteristic length scale of the field line.

35437 Anode spot plasma torch. Ghaemi, M.S. (Univ. of Iowa, Iowa City, IA (US)); Seyhoonzadeh, A.; Lim, W.B.; Tao, J.; Cooney, J.; Forsling, P.; Bailey, M.; Lonngren, K.E. *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science (USA),* 17(2): 342-343 (Apr 1989).

With acetone as a catalyst in an argon discharge plasma, it is observed that localized high-density anode spots can be formed at sharp edges in the plasma. By placing the sharp edge on top of a small permanent magnet, the current which is attracted to the spot can locally burn a piece of metal beneath the sharp edge.

35438 Long-term development of elongated tokamak plasmas after failure of feedback stabilization. Jensen, T. H. (General Atomics, P.O. Box 85608, San Diego, California 92138(US)); Chu, M. S. *Physics of Fluids B: Plasma Physics (USA),* 1(7): 1545-1547 (Jul 1989).

Tokamaks with cross sections elongated in the axial direction are subject toan instability that basically involves an axial displacement of the plasma. Thisinstability can be stabilized by a feedback circuit. This Brief Communicationdeals with the long-term development of the plasma after a failure of thefeedback circuit during an otherwise normal discharge. The short-term (linear)development of such a plasma was considered earlier by Yokomizo *et*. [Nucl. Fusion **23**, 1593 (**1983**)]. During thelong-term development, the plasma makes intimate contact with the surroundingconducting shell (vacuum vessel). The timescale for this development is longcompared to the Alfven time, so that it is appropriate to consider the plasmain a magnetohydrodynamic (MHD) equlibrium which evolves slowly. This equilibrium(assumed axisymmetric) is unusual in that currents and forces are exchangedbetween the shell and the plasma. The dynamics of the equilibrium is determinedby Ohmic dissipation associated with the plasma currents and the toroidal andpoloidal currents of the shell. For a "typical" large tokamak, it is foundthat dissipation in the shell may dominate. Modeling of such long-termdevelopment may be important because the forces acting on the shell due to theshell currents may be large. It may be important that dissipation in the plasmacan be neglected or that it is small in such modeling since the uncertainty ofthe results, due to uncertainties associated with the plasma, is absent or maybe small.

35439 2D Fokker-Planck simulations of short-pulse laser-plasma interactions. Rickard, G. J. (Blackett Laboratory, Imperial College of Science and Technology, Prince Consort Road, London SW7 2BZ, United Kingdom(GB)); Bell, A. R.; Epperlein, E. M. *Physical Review Letters (USA),* 62(23): 2687-2690 (5 Jun 1989).

The Fokker-Planck equation for electrons in two spatial dimensions in thediffusive approximation is solved by the alternating direction implicit method.The ions are modeled hydrodynamically. We discuss simulations of short-pulse(3.4 psec) experiments at a wavelength of 1/4 μm. We findsubstantial departures from Spitzer heat flow in both magnitude *and*direction. As a result we find that, even for 10-μm-diam laser spots,the heat flow into the target is not strongly reduced by energy escaping alongthe target surface.

35440 Competition between the stimulated Raman and Brillouin scattering instabilities in 0.35-μm irradiated CH foil targets. Baldis, H. A. (National Research Council, Ottawa, Ontario, Canada K1A 0R6(US)); Young, P. E.; Drake, R. P.; Kruer, W. L.; Estabrook, K.; Williams, E. A.; Johnston, T. W. *Physical Review Letters (USA),* 62(24): 2829-2832 (12 Jun 1989). DOE Contract W-7405-ENG-48.

The first experimental evidence of modification of the scattered light spectrum of stimulated Raman scattering due to the presence of significant levels of stimulated Brillouin scattering is presented. The observed spectrum, as well as the spectral *Raman gap* observed in this and other experiments, is explained in terms of the modified growth of Raman in the presence of ion waves.

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Refer also to citation(s) 34003, 34150, 34227, 35409, 35426, 35434, 35436

35441 (ACIESP–60(v.3), pp. 314-319) **Random distribution of magnetic field lines in tokamaks.** Heller, M.V. (Sao Paulo Univ., SP (Brazil). Inst. de Fisica); Caldas, I.L. Academia de Ciencias do Estado de Sao Paulo, SP (Brazil). 1988. (CONF-8808156–: 6. Japan-Brazil symposium on science and technology, Sao Paulo, Brazil, 10-12 Aug 1988). In *Proceedings of the 6. Japan-Brazil Symposium on Science and Technology.* Order Number DE89612371/JAW. Available from NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS.

Magnetic surface break-up caused by overlapping of magnetic islands, created by resonant helical windings and by plasma oscillations, is investigated integrating numerically the differential equations for the magnetic field lines.

35442 (CEA-CONF–9763) **Problems in tritium handling in fusion reactors studies at CEA within the european effort.** Roth, E.; Hircq, B.; Fidelle, J.P. CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI). 1988. 26p.

(CONF-8806374–: Workshop on ceramic materials for fusion, Tokyo, Japan, Jun 1988). Order Number DE89781430/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Technological aspects of tritium handling linked with the operation of a fusion reactor are reviewed. Tritium storage is discussed from the point of view of the volumme of a single unit and of the nature of the metal bed. Purification of tritium and recovery from tritiated compounds is studied, including conversion from water to the gaseous form. Interaction of tritium and structural materials is developed from the point of view of corrosion, embrittlement, permeation. A flowsheet displaying a conception of a reference tritium circuit is proposed, and consideration is given to specifications of large components, namely pumps and gatevalves for tritium circuits.

35443 (CONF-8904215–3) **Desorption activation energies for tritium release from ceramic breeders.** Kopasz, J.P.; Fischer, A.K.; Johnson, C.E. Argonne National Lab., IL (USA). 1989. 20p. Sponsored by DOE Energy Research. DOE Contract W-31109-ENG-38. From Symposium on fabrication and properties of lithium ceramics; Indianapolis, Indiana, USA; 24-26 Apr 1989. Order Number DE89014667/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Desorption has been identified as an important process in determining the kinetics of tritium release from ceramic tritium breeder materials considered for use in fusion reactors. However, details of the desorption of tritium from ceramic materials are mostly unknown. Models of tritium release have treated desorption as a simple process with desorption occurring from one type of site with one activation energy. Recent measurements of the rates of water uptake by $LiAlO_2$, and evolution of water from $LiAlO_2$ exposed to water, indicate the presence of multiple types of desorption sites. Estimates of desorption activation energies were obtained from these data and from data in the literature suggesting multiple types of desorption sites for desorption from Li_2O and Li_4SiO_4. 15 refs., 4 figs.

35444 (DOE/DP/40131–02) **Technical progress report for measurement of ambipolar potential of laser fusion targets: Bi-monthly report, December 1, 1980–January 31, 1981.** Stringfield, R. Physics International Co., San Leandro, CA (USA). 28 Feb 1981. 8p. Sponsored by DOE Defense Programs. DOE Contract AC08-80DP40131. Order Number DE89013017/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The general design of this spectrometer has been completed. A meeting was held at the University of Rochester to review the experiment. The delay in the completion of the spectrometer by ARACOR is expected to be 4 to 5 weeks.

35445 (DOE/DP/40131–04) **Technical progress report for measurement of ambipolar laser fusion targets: Bi-monthly report, April 1, 1981–May 31, 1981.** Stringfield, R. Physics International Co., San Leandro, CA (USA). 30 Jun 1981. 9p. Sponsored by DOE Defense Programs. DOE Contract AC08-80DP40131. Order Number DE89013019/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Assembly of the spectrometer hardware and electronics is underway. The microballoons for the main experiment have been chosen. Discussions were held with personnel at the Stanford Tandem Van de Graaff Facility in preparation for calibration of the spectrometer.

35446 (ENEA-RT-FUS–88-10, pp. 5-9) **Conductor design for NET machine.** Bruzzese, B. (Associazione EURATOM-ENEA sulla Fusione, Frascati (Italy)); Catitti, A.; Cerreta, R.; Della Corte, A.; Pasotti, G.; Ricci, M.V.; Sacchetti, N.; Spadoni, M. ENEA, Rome (Italy). 1988. (CONF-880736–: 12. international cryogenic engineering conference and exhibition, Southampton, UK, 12-15 Jul 1988). In *Contributions to the 12th. International Cryogenic Engineering Conference. Southampton, 12-15 July 1988.* Order Number DE89612427/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

As the present NET specifications call for a toroidal magnetic field of about 5 T on the plasma axis the geometry of the TF coils system will require a maximum magnetic field on the conductor of about 11 T. A superconducting magnet system fulfilling these conditions can be designed on the basis of the present technology choosing one of the two following solutions: (1) a Nb-Ti conductor cooled by means of pressurized superfluid helium at 1.8 K; (2) an A-15 based conductor cooled by liquid Helium at temperatures around 4.5 K.

35447 (IAEA-R–2927-F) **Laboratory scale development of coating for improving characteristics of candidate materials for fusion reactor. Final report for the period 1 October 1981 - 30 November 1988.** Agarwala, R.P. Bhabha Atomic Research Centre, Bombay (India). Chemistry Div.; International Atomic Energy Agency, Vienna (Austria). Jan 1989. 104p. Order Number DE89617686/JAW. Available from NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS.

Application of coatings of refractory low atomic number materials on to different components of Tokamak type controlled thermonuclear reactor are expected to provide a degree of design flexibility. The project envisages to deal with the challenging problem on laboratory scale. Coatings investigated include carbon, beryllium, boron, titanium carbide and alumina and substrates chosen have been 304, 316 stainless steels, monel-400, molybdenum, copper, graphite, etc. For their deposition, different techniques (e.g. evaporation, sputtering and their different variants) have been tried, appropriate ones chosen and their parameters optimized. The coating composition has been analyzed using X-ray diffraction (XRD), Auger electron spectroscopy (AES), X-ray photoelectron spectroscopy (XPS), Rutherford backscattering analysis (RBS) and secondary ions mass spectroscopy (SIMS). Surface morphology has been studied using scanning electron microscopy (SEM). Sebastian coating adherence tester has been used for adhesion measurement and Wilson's Tukon microhardness tester for their microhardness measurement. The coatings have been subjected to pulses from YAG laser to evaluate their thermal cycling behaviour. Deuterium ion bombardment (Energy: 20-120 keV; doses: 10^{19}-$9.3x10^{20}$ ions/cm^2) behaviour has also been studied. In general, adherent and hard coatings capable of withstanding thermal cycling could be deposited. Out of the coatings studied, titanium carbide shows best results. The following pages are reprints and not mircrofiched: p. 25-32, 39-41, 57-81. Bibliographic description is on page 13.

35448 (INIS-mf–11454, pp. 63-65) **Cryomagnetic systems for plasma heating in tokamaks.** Chovanec, F. (Slovenska Akademia Ved, Bratislava (Czechoslovakia). Elektrotechnicky Ustav); Kokavec, J.; Krempasky, I.; Usak, P.; Polak, M.; Jansak, L. Ceskoslovenska Vedeckotechnicka Spolecnost, Usti nad Labem (Czechoslovakia). Dum Techniky. Apr 1988. (In Slovak). (CONF-8804279–: Cryogenics '88, Usti nad Labem, Czechoslovakia, 19-21 Apr 1988). In *Cryogenics '88.* Order Number DE89617941/JAW. Available from NTIS (US Sales Only), PC A10/MF A01 - OSTI; INIS.

Cryomagnetic systems for gyrotron plasma heating in tokamaks were designed and tested. The systems consists of superconducting split pair coils providing a 5 T magnetic field with a defined axial field profile, correcting coils, helium cryostats and computer controlled power supply units. Presented are the design, construction and test results of a number of systems. (author). 2 figs.

35449 (INIS-mf–11456, pp. 131-136) **Thermonuclear reactions.** Kopecky, V. (Ceskoslovenska Akademie Ved, Prague (Czechoslovakia). Ustav Fyziky Plazmatu); Zacek, F. Jednota Ceskoslovenskych Matematiku a Fyziku, Prague (Czechoslovakia). 1987. (In Czech). (CONF-8707217–: 9. conference of Czechoslovak physicists, Pardubice, Czechoslovakia, 6-10 Jul 1987). In *Ninth conference of Czechoslovak physicists. Part 1, 2.* Order Number DE89617602/JAW. Available from NTIS (US Sales Only), PC A22/MF A01 - OSTI; INIS.

Present (1986) state of the art of the world thermonuclear research is briefly surveyed. During the last three decades, plasma parameters in experimental devices are slowly but steadily approaching the limit of the break-even given by the Lawson criterion. Both the magnetic and inertial confinement schemes are intensively investigated. Among various alternative ways of magnetic confinement, the decisive proof of feasibility of the controlled fusion is expected from the new generation tokamaks. In the last period, substantial progress was achieved in the methods of additional plasma heating (pellet and neutral beam injection and high-frequency heating). Also encouraging results on the non-inductive current drive were obtained. The main results of experiments on

large tokamaks are recapitulated and further prospects of international cooperation discussed. The Czechoslovak contributions in the field in the question are mentioned. (J.V.). 3 figs., 1 tab., 12 refs.

35450 (INIS-mf–11456, pp. 447-450) **Polarization experiments in fusion reactions of light nuclei.** Bem, P. (Ceskoslovenska Akademie Ved, Rez (Czechoslovakia). Ustav Jaderne Fyziky). Jednota Ceskoslovenskych Matematiku a Fyziku, Prague (Czechoslovakia). 1987. (In Czech). (CONF-8707217–: 9. conference of Czechoslovak physicists, Pardubice, Czechoslovakia, 6-10 Jul 1987). In *Ninth conference of Czechoslovak physicists. Part 1, 2.* Order Number DE89617602/JAW. Available from NTIS (US Sales Only), PC A22/MF A01 - OSTI; INIS.

The present research activity of the Department of Nuclear Reactions, Czechoslovak Institute of Nuclear Physics, aims at studying the role of spin orientation in fusion reactions of light nuclei at energies close to the reaction threshold. The polarization effects might be of great importance especially in connection with the possibility of controlling the reactivity of a spin-polarized plasma. Detailed knowledge of the fusion reaction kinetics in indispensable also for the practical application of muon-catalyzed fusion. For experimental investigation of contributions of higher-order partial waves in reactions of polarized deuterons on a tritium target, a complex experimental apparatus was set up. Simultaneously, a sophisticated method of theoretical analysis of experimental data was developed. The latter was tested on the results of the Los Alamos experiment with polarized deuterons. (J.V.). 4 figs., 8 refs.

35451 (JAERI-M–88-241) **Experiments on D-T neutron source characteristics of an FNS high speed water cooled target.** Ikeda, Yujiro; Oyama, Yukio; Fukahori, Tokio; Maekawa, Hiroshi; Nakamura, Tomoo. Japan Atomic Energy Research Inst., Tokyo (Japan). Dec 1988. 46p. (In Japanese). Order Number DE89778090/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The D-T neutron source is essential for the fusion neutronics experiments and it is of importance to characterize the source conditions in order to perform the experiment as well as analysis with high accuracy. A fast water cooled D-T target system at the end of the 80deg beam line of FNS accelerator was installed for the fusion blanket integral experiments. The target assembly has a rather complex and tight structure in order to reduce high heat production due to high incident d^+ beam current at the target position. It is expected that the target structure influences the neutron spectrum and angular distributions of the neutrons emitted from the assembly. Prior to successive blanket neutronics experiments, measurements have been carried out on the source characteristics. The angular distribution of the neutron fluxes on horizontal, vertical and axial planes were measured with the foil activation technique. The angular distribution was also measured by an NE213 scintillation counter using a dual rotatable deck. The angles dependent neutron spectra around the target were obtained with TOF technique. Experimental results were discussed on the basis of the nuclear reaction kinematics for $^3T(d,n)^4He$ by taking the target structure into account. As a result, it was proved that the structure of the assembly affects significantly the neutron emission character. The experimental data obtained will be used for verification of analytical calculation of D-T source.

35452 (JAERI-M–88-246) **Results of pellet injection experiments in JT-60.** Yoshino, Ryuji. Japan Atomic Energy Research Inst., Tokyo (Japan). Dec 1988. 17p. Order Number DE89778091/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

This paper presents recent experimental results of pellet injection to joule plasma and heating experiments of pellet injected plasma by NB, LHRF, and ICRF. Especially clear improvement in confinement has been obtained in NB heating of pellet injected plasma up to 10-15 MW in Ip = 1.5-1.8 MA lower-side X-point divertor configuration.

35453 (JAERI-M–88-251) **Safety analysis and evaluation of the next fusion device.** Kobayashi, Shigetada; Honda, Tsutomu; Ohmura, Hiroshi; Kawai, Masayoshi; Shimizu, Takeshi; Yamaoka, Mitsuaki; Nakahara, Katsuhiko; Seki, Yasushi. Japan Atomic Energy Research Inst., Tokyo (Japan). Dec 1988. 308p. (In Japanese). Order Number DE89778110/JAW. Available from NTIS (US Sales Only), PC A14/MF A01.

As a part of safety evaluation, a probabilistic risk assessment (PRA) has been attempted for the Next Fusion Device system. Among the various events related to safety, a number of representative events have been selected for assessment, from the events in normal operation state, repair and maintenance state and accidental state. In the first chapter, in order to conduct the probabilistic risk assessment of the whole Fusion Experimental Reactor (FER), the data base required for the analysis was investigated in 1.1, the results on the failure mode and effects analysis (FMEA), accident sequence, radioactive inventory leakage flow path, event tree analysis (ETA) and fault tree analysis (FTA) were summarized in 1.2 to 1.5, respectively. Based on these results, accident initiating events were evaluated in 1.6, and overall risk was assessed in 1.7 and the tasks for the future were summarized in 1.8. It is important to analyze and evaluate various events during normal operations, repair and maintenance and accidents. However, due to the large uncertainties in the modeling of phenomena or the data base, there are many events for which realistic analyses are difficult. Three such events were selected and studied in chapter two. In 2.1, the temperature rise in the reactor structure after the Loss-of-Coolant-Accident caused by the decay heat under various heat removal conditions were investigated. In 2.2, the radiation dose of personnel during repair and maintenance period caused by the release of activated dust were estimated. Lastly, in 2.3 tritium behavior in the stainless steel first wall and graphite armour were studied.

35454 (JAERI-M–88-253) **Hydrogen isotope separation study with TSTA cryogenic distillation system. Single column experimet with D-T system.** Yamanishi, Toshihiko; Yoshida, Hiroshi; Naito, Taisei; Hirata, Shingo; Sherman, R.H.; Bartlit, J.R.; Anderson, J.L. Japan Atomic Energy Research Inst., Tokyo (Japan). Dec 1988. 24p. Order Number DE89778112/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

An experimental study of cryogenic distillation was performed with deuterium-tritium (60 g of tritium) by using one column in the TSTA (Tritium System Test Assembly) isotope separation system. The overall HETP values were 4 ~ 5.7 cm for the total reflux mode and 5 ~ 5.5 cm for the total recycle mode. The values for both operation modes increased slightly with the vapour velocity. No effect of the reflux ratio on the overall HETP was observed. The HETP depended little on the column height. The dynamic column behaviour predicted by mathematical simulation modeling was in qualitative agreement with the experimental observation.

35455 (JAERI-M–88-254) **Hydrogen isotope separation study with the TSTA cryogenic distillation system. Two-column experiment with H-D-T.** Yamanishi, Toshihiko; Yoshida, Hiroshi; Fukui, Hiroshi; Naito, Taisei; Hirata, Shingo; Sherman, R.H.; Gruetzmacher, K.M.; Bartlit, J.R.; Anderson, J.L. Japan Atomic Energy Research Inst., Tokyo (Japan). Dec 1988. 33p. Order Number DE89778093/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Cryogenic distillation cascade experiments were performed using two columns in the TSTA (Tritium System Test Assembly) isotope separation system with H-D-T. Both columns, differing in packed height and inner diameter, confirmed the overall HETP values were approximately 5 cm and relatively constant within the column. The dynamic behaviour of the cascade was also discussed, and a basic control method was proposed.

35456 (JAERI-M–88-268) **Bibliographic data on surface processes in particle-material interactions published in Japan, 1986-1987.** Gesi, Kazuo; Nagai, Siro; Ozawa, Kunio. Japan Atomic Energy Research Inst., Tokyo (Japan). Jan 1989. 133p. Order Number DE89778129/JAW. Available from NTIS (US Sales Only), PC A07/MF A01.

Data on surface processes in particle-material interactions for fusion technology have been surveyed and collected over 24 publications which have been published during January, 1986 - December, 1987 in Japan. The bibliographic data in the form of data sheets were sent to the International Data Center in IAEA. This report presents 97 selected data sheets arranged in the order of codes of relevant phenomena. A list of literature is given. (author) 159 refs.

35457 (LBL–25432) **Heavy Ion Fusion Accelerator Research (HIFAR) year-end report, October 1, 1987–March 31, 1988.** Lawrence Berkeley Lab., CA (USA). Jun 1988. 28p. Sponsored by DOE Energy Research. DOE Contract AC03-76SF00098. (HIFAN–397). Order Number DE89013417/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The basic objective of the Heavy Ion Fusion Accelerator Research (HIFAR) program is to assess the suitability of heavy ion accelerators as igniters for Inertial Confinement Fusion (ICF). A specific accelerator technology, the induction linac, has been studied at Lawrence Berkeley Laboratory and has reached the point at which its viability for ICF applications can be assessed over the next few years. The HIFAR program addresses the generation of high-power, high-brightness beams of heavy ions, the understanding of the scaling laws in this novel physics regime, and the validation of new accelerator strategies, to cut costs. Key elements to be addressed include: beam quality limits set by transverse and longitudinal beam physics; development of induction accelerating modules, and multiple-beam hardware, at affordable costs; acceleration of multiple beams with current amplification – both new features in a linac – without significant dilution of the optical quality of beams; and final bunching, transport, and accurate focusing on a small target.

35458 (LBL–25985) **The Berkeley 2 MV heavy ion fusion injector.** Rutkowski, H.L.; Faltens, A.; Vanecek, D.; Pike, C.; Brodzik, D.; Johnson, R.M.; Meyer, E.A.; Humphries, S. Jr. Lawrence Berkeley Lab., CA (USA). Mar 1989. 3p. Sponsored by DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-890335–190: 13. particle accelerator conference, Chicago, Illinois, USA, 20-23 Mar 1989). Order Number DE89012980/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This paper is an update on the development of the 500 mA per beam sixteen beam injector being built at LBL. An inductively graded Marx bank provides the acceleration potential on the electrostatic column. A carbon arc source provides the pulsed current for the injector. We report recent results on extracted beam parameters, column performance, the generator performance, and system design changes. The carbon ion beam is diagnosed with Faraday cups and with a double slit emittance measurement system. Controls for the final machine are also discussed. 7 refs., 4 figs.

35459 (LBL–25989) **Report on the symposium on heavy ion inertial fusion, Darmstadt, Germany, June 1988.** Keefe, D. Lawrence Berkeley Lab., CA (USA). Mar 1989. 5p. Sponsored by DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-890335–195: 13. particle accelerator conference, Chicago, Illinois, USA, 20-23 Mar 1989). Order Number DE89013694/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The Symposium hosted by GSI attracted about 130 participants from 12 countries. Progress in developments for high-current low-emittance heavy ion beams in both rf linacs and induction linacs has been reported. Significant current amplification in a proof-of-principle multiple-beam induction linac was described. Experimental results from France and Germany show enhanced energy deposition by low-energy heavy ions in hot dense plasmas. The GSI heavy ion synchrotron (SIS) and the experimental storage ring (ESR) are under construction; when completed, the beams will be used for experiments to study hot dense plasma phenomena. 28 refs., 6 figs.

35460 (LBL–25995) **Acceleration units for the Induction Linac Systems Experiment (ILSE).** Faltens, A.; Brady, V.; Brodzik, D.; Hansen, L.; Laslett, L.J.; Mukherjee, S.; Bubp, D.; Ravenscroft, D.; Reginato, L. Lawrence Berkeley Lab., CA (USA). Mar 1989. 3p. Sponsored by DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-890335–194: 13. particle accelerator conference, Chicago, Illinois, USA, 20-23 Mar 1989;HIFAN–409). Order Number DE89013688/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The design of a high current heavy ion induction linac driver for inertial confinement fusion is optimized by adjusting the acceleration units along the length of the accelerator to match the beam current, energy, and pulse duration at any location. At the low energy end of the machine the optimum is a large number of electrostatically focused parallel beamlets, whereas at higher energies the optimum is a smaller number of magnetically focused beams. ILSE parallels this strategy by using 16 electrostatically focused beamlets at the low end followed by 4 magnetically focused beams after beam combining. 3 refs., 2 figs.

35461 (LBL–25998) **Engineering study of a 10 MeV heavy ion linear accelerator.** Fong, C.G.; Fessenden, T.J.; Fulton, R.L.; Keefe, D. Lawrence Berkeley Lab., CA (USA). Mar 1989. 4p. Sponsored by DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-890335–188: 13. particle accelerator conference, Chicago, Illinois, USA, 20-23 Mar 1989;HIFAN–408). Order Number DE89012999/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

LBL's Heavy Ion Fusion Accelerator Research group has completed the engineering study of the Induction Linac Systems Experiment (ILSE). ILSE will address nearly all accelerator physics issues of a scaled heavy ion induction linac inertial fusion pellet driver. Designed as a series of subsystem experiments, ILSE will accelerate 16 parallel carbon ion beams from a 2 MeV injector presently under development to 10 MeV at one μsec. This overview paper will present the physics and engineering requirements and describe conceptual design approaches for building ILSE. Major ILSE subsystems consist of electrostatic focusing quadrupole matching and accelerating sections, a 16 to 4 beam transverse combining section, a 4 beam magnetic focusing quadrupole accelerating section, a single beam 180 degree bend section, a drift compression section and a final focus and target chamber. These subsystems are the subject of accompanying papers. Also discussed are vacuum and alignment, diagnostics/data acquisition and controls, key conclusions and plans for further development. 10 refs., 4 figs., 1 tab.

35462 (LBL–26167) **2-D emittance equation with acceleration and compression.** Hahn, K.D.; Smith, L. Lawrence Berkeley Lab., CA (USA). Oct 1988. 7p. Sponsored by DOE Energy Research. DOE Contract AC03-76SF00098. (HIFAN–415). Order Number DE89012860/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Since both acceleration and compression are required for an Inertial Fusion Driver, the understanding of their effect on the beam quality, emittance, is important. This report attempts to generalize the usual emittance formula for the drifting beam to include these effects. The derivation of the 2-D emittance equation is carried out and a comparison with the particle code results is given. The 2-D emittance at a given axial location is reasonable to consider for a long beam, particularly with velocity tilt; transverse emittance averaged over the entire bunch is not a useful quantity. 6 refs., 2 figs., 1 tab.

35463 (LBL–26482) **Heavy Ion Fusion Accelerator Research (HIFAR) year-end report, April 1–September 30, 1988.** Lawrence Berkeley Lab., CA (USA). Dec 1988. 24p. Sponsored by DOE Energy Research. DOE Contract AC03-76SF00098. (HIFAN–419). Order Number DE89012858/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The basic objective of the Heavy Ion Fusion Accelerator Research (HIFAR) program is to assess the suitability of heavy ion accelerators as igniters for Inertial Confinement Fusion (ICF). A specific accelerator technology, the induction linac, has been studied at the Lawrence Berkeley Laboratory and has reached the point at which its viability for ICF applications can be assessed over the next few years. The HIFAR program addresses the generation of high power, high-brightness beams of heavy ions, the understanding of the scaling laws in this novel physics regime, and the validation of new accelerator strategies, to cut costs. Key elements to be addressed include: beam quality limits set by transverse and longitudinal beam physics; development of induction accelerating modules, and multiple-beam hardware, at affordable costs; acceleration of multiple beams with current amplification –both new features in a linac – without significant dilution of the optical quality of the beams; final bunching, transport, and accurate focusing on a small target.

35464 (SAND–88-3238C) **Improvements in synchronization of the PBFA-II accelerator with laser-triggered gas switches.** Wilson, J.M.; Donovan, G.L. Sandia National Labs., Albuquerque, NM (USA). 1989. 14p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890665–8: 7. Institute of Electrical and Electronics Engineers pulsed power conference, Monterey, California, USA, 12-14 Jun 1989). Order Number DE89013067/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

PBFA II is a 36-module ion accelerator built by Sandia National Laboratories for inertial confinement fusion studies. In the water-filled, pulse-forming section of the accelerator, each module is fitted with a 5.0-MV, SF_6-filled gas switch located between an intermediate storage capacitor and the first pulse forming line. The intermediate storage capacitor is charged to 4.8-5.0 MV in approximately 950 ns by a Marx generator located in the oil section of the machine. The gas switch is required to close on command and transfer the stored capacitor energy to Line 1, a coaxial transmission line of 100 ns two-way electrical length. The switches are triggered by a single 3.0-J KrF laser located under the accelerator; a complex beam-splitting/distribution system is used to deliver 20-40 mJ, 35 ns FWHM beamlets to the individual switches. In order to properly drive the experimental load on PBFA II, equal-amplitude pulses must be produced by each pulse-forming line with a module-to-module first-to-last timing difference (spread) of less than 20 ns. The gas switch, the last command-triggered point in the module, is the major determinant of total machine synchrony. To compensate for the additional (<3 ns) rms jitter of three sets of self-breaking water switches downstream of the gas switches, first-to-last timing spread of the 36 gas switches must be less than 15 ns. 5 refs., 6 figs.

35465 (SAND–89-0091C) **Improved core insulation schemes for multi-terawatt magnetic switches.** Harjes, H.C.; Mann, G.A.; Neau, E.L.; Morgan, F.A. Sandia National Labs., Albuquerque, NM (USA). 1989. 5p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890665–21: 7. Institute of Electrical and Electronics Engineers pulsed power conference, Monterey, California, USA, 12-14 Jun 1989). Order Number DE89013814/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The operation of multi-terawatt magnetic switches was successfully demonstrated in the CometII pulsed power module in 1984. Those switches, however, had short lifetimes (<100 shots) due to inter-lamina dielectric breakdowns at electric-field levels far lower than expected. Since then, experiments have been conducted to gain an understanding of this problem. We found that the breakdowns occurred at low electric-field levels, because the thin dielectric film (Mylar) was abrasively degraded by the relatively rough surface of the magnetic tape (Metglas) during the core winding process. This problem can be solved by modifying the Metglas surface before winding. A factor of 2 improvement in breakdown level, from .8 MV/cm to 1.6 MV/cm, has been demonstrated on the MSTF module (a Marx driven, 500 kV, 2 Ω, 50 ns PFN) in 18" OD switches wound with Electrodag coated Metglas (nominal coating thickness ~6 μm). Even better performance has been achieved in smaller scale tests with an electrophoretically applied plastic-coated Metglas. A description of these experiments and a discussion of the results will be presented. 7 refs., 10 figs., 1 tab.

35466 (SAND–89-0274C) **Ion sources for light-ion fusion.** Gerber, R.A.; Bieg, K.W.; Dreike, P.L.; McKay, P.F.; Pregenzer, A.L.; Tisone, G.C.; Woodworth, J.R. Sandia National Labs., Albuquerque, NM (USA). 1989. 38p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890703–3: International conference on ion sources, Berkeley, California, USA, 9-15 Jul 1989). Order Number DE89012639/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Light-ion drivers offer a potentially efficient and low-cost method to compress and heat an Inertial-Confinement Fusion (ICF) target. In order to produce a significant thermonuclear burn of the fuel, focused ion-beam intensities of 100 TW/cm^2 are required. The ion sources for these pulsed-power drivers should produce a single-ion species and should be capable of providing current-density levels up to 5 kA/cm^2, in pulse widths of 10 ns to 20 ns, at voltages up to several tens of megavolts. Most ion sources used in the past have produced multiple-ion species, including protons and heavier ions, such as carbon and oxygen. In the last few years there has been a substantial research effort to produce single-species sources. The major effort since 1983 has been directed towards developing a pure, high-current Li^+ source for the light-ion fusion accelerator, PBFA II. There are two types of ion sources being used for intense in-beam generation: passive sources, which are produced directly or indirectly by the diode voltage itself, and active sources, in which a preformed plasma is generated before the arrival of the power pulse. A survey of existing ion sources and those under development will be given. Emphasis will be given to the lithium-ion sources being developed at Sandia National Laboratories (SNL). 39 refs., 7 figs.

35467 (SAND–89-0276C) **Lithium fluoride ion source experiments on PBFA II.** Bieg, K.W.; Pregenzer, A.L.; Woodworth, J.R.; Lockner, T.R.; Johnson, D.J.; Gerber, R.A.; Bailey, J.E.; Kensek, R.P.; Leeper, R.J.; Maenchen, J.E. Sandia National Labs., Albuquerque, NM (USA). 1989. 16p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890703–6: International conference on ion sources, Berkeley, California, USA, 9-15 Jul 1989). Order Number DE89013562/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Lithium fluoride, field-enhanced ion source experiments are being performed on PBFA II. The source consists of a thin coating of LiF on a microscopically rough substrate. Diagnostics to measure ion beam energy, purity, and transport include electrical monitors, Faraday cups, nuclear activation, ion pinhole camera, Rutherford magnetic spectrograph, and shadowbox aperture array, With PBFA II operating at three-quarters energy, the source has produced 16 TW of ion power and 550 kJ of ion energy with 70% diode efficiency. Over 26 kJ of lithium beam energy has been focused to the diode center axis with a peak energy density of about 1.3 kJ/cm^2. PICDIAG simulations of the lithium focus indicate the intrinsic source divergence is about 45 mrad with a 20-μm-grade porous stainless steel substrate. 13 refs., 4 figs.

35468 (SAND–89-1458C) **PBFA II applied B-field ion diode proton beam characteristics.** Johnson, D.J.; Locknew, T.R.; Leeper, R.J.; Maenchen, J.E.; Mendel, C.W.; Rochau, G.E.; Stygar, W.A.; Coats, R.S.; Desjarlais, M.P.; Kensek, R.P. Sandia National Labs., Albuquerque, NM (USA). 1989. 15p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890665–17: 7. Institute of Electrical and Electronics Engineers pulsed power conference, Monterey, California, USA, 12-14 Jun 1989). Order Number DE89014782/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

An applied B-field ion diode on PBFA II has produced a 17 TW proton beam for investigation of beam generation and transport physics pertinent to inertial confinement fusion experiments. Power was fed to the diode via two conical self-magnetically-insulated transmission lines that incorporated plasma opening switches. The diode utilized a pair of B-field coils in disc shaped cathodes to produce a 3 T axial B-field that insulated the 16 mm anode-cathode gap from electron loss. The 15-cm-radius anode was configured with a 5.5-cm-tall curved ion emitting region. A 2.6 MA ion beam originated from this region, was accelerated to 6 MV in the anode-cathode gap, and then transported ballistically toward the axis in a current neutralizing gas cell. The best transport (75%) occurred with narrow 5.5-cm-tall anode sources in which a 180 kJ proton beam was observed within 1.2 cm of the diode centerline. The FWHM of the beam focused at the centerline of the diode was 5 to 7 mm. This beam gave a peak proton power density of approximately 5 TW/cm^2. 12 refs., 8 figs.

35469 (SAND–89-1494C) **Theory, simulation, and experiment of a single module coax-to-parallel-plate transition for the transformer section of PBFA II.** Johnson, W.A.; Schneider, L.X.; Neau, E.L. Sandia National Labs., Albuquerque, NM (USA). 1989. 5p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890665–14: 7. Institute of Electrical and Electronics Engineers pulsed power conference, Monterey, California, USA, 12-14 Jun 1989). Order Number DE89013493/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Techniques are being developed to gain understanding of energy transport efficiencies through changes in pulsed power transmission line geometries. These techniques are being applied to design study of the PBFA-II accelerator which has the goal of increasing the energy available for ICF experiments. Transverse electromagnetic (TEM) wave analysis yields a simple circuit model of the new coax-to- parallel-plate transition. This simple model gives insight into the dominant physics of the device and suggests design improvements that will lead to the desired energy efficiencies. Insights gained by this simple model are confirmed and refined by 3-dimensional, time dependent computer simulations with the SOS code and scale

model experiments. Simulations have predicted experimental results to high degree of accuracy which adds confidence in both the simulations and the scale model experiments. 1 ref., 11 figs., 1 tab.

35470 (UCRL–100012) **Passive optical losses in laser glass.** Caird, J.A.; Milanovich, F.P.; Nielsen, N.D.; Powell, H.T.; Marion, J.E.; Pertica, A.J.; Roe, J.N. Lawrence Livermore National Lab., CA (USA). 11 May 1989. 21p. Sponsored by DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-890423–10: CLEO '89: conference on lasers and electro optics, Baltimore, Maryland, USA, 24-28 Apr 1989). Order Number DE89013784/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Background absorption, scattering, and stress-birefringence loss measurements are reported for phosphate laser glass amplifier media used in fusion and high average power laser systems. Typical background absorption and stress birefringence losses were found to be comparable, and on the order of 10^{-3} cm^{-1}. Scattering losses, on the other hand, were typically found to be more than an order of magnitude smaller. The results indicate that improvements in the cost/performance ratio can be achieved by reducing background absorption of birefringence, and possibly also through the use of cheaper polishing techniques. 6 refs.

99 GENERAL AND MISCELLANEOUS

Refer also to citation(s) 33335

35471 (INIS-GB–190) **UKAEA underlying research programme annual report. April 1987 - March 1988.** Mason, J.P. (ed.). UKAEA Harwell Lab. (UK). Financial Dept. Nov 1988. 167p. Order Number DE89620462/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

Work from all technical areas of the Authority's underlying research programme is described. This is typically in the form of an interim progress report for the year April 1987 to March 1988. The seventeen chapters report research into radiation damage, fracture studies, chemical effects at surfaces, surface physics and corrosion, fluid mechanics and heat transfer, nuclear studies, neutron beam studies, theoretical sciences, instrumentation, reactor physics and control, fabrication processes, laser isotope separation, nuclear fuel cycle studies, quantum electronics, radiological protection, and miscellaneous underlying research.

35472 (SAND–89-1112C) **Seals task force activities.** Waddoups, I.G. Sandia National Labs., Albuquerque, NM (USA). 1989. 3p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890736–4: 30. annual meeting of the Institute of Nuclear Materials Management, Orlando, Florida, USA, 9-12 Jul 1989). Order Number DE89014744/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The Department of Energy (DOE) established the seals task force in 1986 to scope the extent of seals problems, develop guidelines and criteria, and recommend improvements. Recent task force activities have been to update the Safeguards Seals Reference manual produced in 1986, lay the groundwork for seal standardization, and make recommendations for general and specific seals problems in the field. This paper will discuss the manual updates and other general task force activities. 5 refs.

9901 Management

Refer also to citation(s) 34715

35473 (CNEA-NT–5/86) **Activities of the years 1985/86 Materials Department.** Comision Nacional de Energia Atomica, Buenos Aires (Argentina). 1986. 258p. (In Spanish). Order Number DE89620469/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS.

The Materials Department of the National Atomic Energy Commission gives a description of the research done during the period 1985/1986 in the following fields; corrosion and transport of matter, transport phenomena, phase solidification and transformation, mechanical properties, theory of the materials behaviour, and special techniques development. Furthermore it is outlined the rendering of services and the advice given to the nuclear power plants and other institutions. Finally a list of publications, courses, seminars, lectures and presentation to congresses are included. (M.E.L.).

35474 (CNEA-NT–7/88) **Summary of activities of the Research Department 1985.** Comision Nacional de Energia Atomica, Buenos Aires (Argentina). 18 May 1989. 96p. (In Spanish). Order Number DE89620471/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

This annual report of teh Research Department concerns the year 1985. It describes the work carried out in the following fields: Physics, Reactor Chemistry, Radiobiology, Prospective and Special Studies, Biomathematics and Radiochemistry. During the year the first experiments employing heavy ion beams of the new electrostatic accelerator Tandar were made. A list of publications of the Department is enclosed here. (M.E.L.).

35475 (DOE/IG–0267) **Exploratory research and development funds at Los Alamos National Laboratory.** USDOE Office of Inspector General, Albuquerque, NM (USA). Western Regional Office. 17 May 1989. 9p. Sponsored by DOE Management & Administration. Available from OSTI.

Public Law 95-39 authorized contractors operating government laboratories to use a reasonable amount of their operating budget to fund employee-suggested projects up to the pilot stage of development. The Department established a program that permitted its multiprogram laboratories, such as the Los Alamos National Laboratory (LANL), to conduct employee-suggested research at the laboratories' discretion. This discretionary program was referred to as Exploratory Research and Development (ER and D). The purpose of this audit was to evaluate the Department's oversight of an LANL's implementation of the ER and D program.

35476 (IAEA-AL–011) **International Atomic Energy Agency's Laboratories at Seibersdorf and in Vienna.** International Atomic Energy Agency, Seibersdorf (Austria). Laboratories. Dec 1988. 63p. Order Number DE89620460/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

The report briefly describes the main research activities performed during 1988 at the IAEA Laboratories at Seibersdorf in the Agriculture Laboratory, Physics-Chemistry-Instrumentation Laboratory and Safeguards Analytical Laboratory as well as the training activities.

35477 (IAEA-INFCIRC–1(Rev.9)) **Information circulars.** International Atomic Energy Agency, Vienna (Austria). Apr 1989. 111p. Order Number DE89620461/JAW. Available from NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS.

The document summarizes the Information Circulars published by the IAEA under the symbol INFCIRC/for the purpose of bringing matters of general interest to the attention of all Members of the Agency. A complete list of INFCIRCs in numerical order with their titles is given in the Annex.

35478 (INIS-mf–11466) **Annual report 1986-87.** Comision Nacional de Energia Atomica, Buenos Aires (Argentina). 1987. 76p. (In Spanish). Order Number DE89620472/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

This report issued by the Argentine National Atomic Energy Commission (CNEA) covers the two-year period 1986-1987. It describs the research and development carried out in the following fields: nuclear power plants; supplies to nuclear power plants; radioisotopes and radiations; radiological protection and nuclear safety; research and development. In the item general aspects other activities performed by CNEA are included, and in the associated firms with CNEA information on the technological development, and goods and services production is provided. (M.E.L.).

35479 (SV-UK–1987-15) **Compilation of results 1987. Nuclear power technology.** Swedish State Power Board, Vaellingby (Sweden). 13 Mar 1987. 69p. (In Swedish). Order Number DE89618370/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

A compilation is carried out which in concentrated form presents reports on research and development within the nuclear energy field covering a two and a half years period. The foregoing report was edited in December 1984. The projects are presendted with title, project number, responsible unit, person to contact and short result

reports. The result reports consist of short summaries over each project. (L.F.).

9902 Mathematics and Computers

Refer also to citation(s) 33165, 33184, 33231, 33287, 33335, 33336, 33401, 33402, 33417, 33420, 33431, 33436, 33490, 33491, 33529, 33531, 33569, 33572, 33583, 33594, 33595, 33596, 33616, 33617, 33627, 33638, 33665, 33690, 33698, 33721, 33725, 33726, 33773, 33846, 33914, 34053, 34079, 34106, 34113, 34118, 34126, 34129, 34130, 34137, 34139, 34217, 34228, 34231, 34235, 34285, 34373, 34384, 34458, 34726, 34758, 34935, 34942, 35176, 35177, 35298, 35311, 35321, 35414

35480 (AD-A–201603/8/XAB) **Parallel processing on transputer arrays for the recognition of objects in infrared images. Memorandum report.** Baker, S.A. Royal Radar Establishment, Malvern (UK). Sep 1988. 16p. (RSRE-MEMO–4197). Available from NTIS, PC A03/MF A01.

This Memorandum describes work done in mapping image-processing algorithms on to transputer arrays. Object classification based on the autocorrelation function has been applied to infrared images. Using the OCCAM programming language, parallel-processing techniques were developed to make use of the concurrency available for communication and calculation. The results for this specific problem are assessed and conclusions drawn on the use of transputers and OCCAM for parallel processing.

35481 (AD-A–201618/6/XAB) **Message-Driven Processor architecture, Version 11. Artificial intelligence memo.** Dally, W.; Chien, A.; Fiske, S.; Horwat, W.; Keen, J. Massachusetts Inst. of Tech., Cambridge, MA (USA). Artificial Intelligence Lab. 18 Aug 1988. 39p. (AI-M–1069). Available from NTIS, PC A03/MF A01.

The Message-Driven Processor is a node of a large-scale multiprocessor being developed by the Concurrent VLSI Architecture Group. It is intended to support fine-grained, message-passing, parallel computation. It contains several novel architectural features, such as a low-latency network interface, extensive type-checking hardware, and on-chip memory that can be used as an associative lookup table. This document is a programmer's guide to the MDP. It describes the processor's register architecture, instruction set, and the data types supported by the processor. It also details the MDP's message sending and exception handling facilities.

35482 (AD-A–201651/7/XAB) **Fast and processor-efficient parallel algorithms for reducible-flow graphs. Technical report.** Ramachandran, V. Illinois Univ., Urbana, IL (USA). Coordinated Science Lab. Nov 1988. 28p. (UILU-ENG–88-2257). Available from NTIS, PC A03/MF A01.

This document presents parallel NC algorithms for recognizing reducible flow graphs (rfg's), and for finding dominators, minimum feedback vertex sets, and a depth first-search numbering in an rfg. All of these algorithms run in polylog parallel time using M (n) processors, where M (n) is the number of processors needed to multiply two nxn matrices in polylog time; this is the best processor bound currently known for polylog-time parallel algorithms for directed graphs. It is shown that finding a minimum feedback vertex in vertex-weighted rfg's or finding a minimum feedback arc set in arc-weighted rfg's is complete. For arc or vertex weights in unary, the authors presents RNC algorithms for these problems and shows that these problems are in NC if and only if the problem of finding a maximum matching is in NC.

35483 (DOE/ER/25026–28) **Parallel methods for the numerical solution of ordinary differential equations.** Tam, Hon Wah. Illinois Univ., Urbana, IL (USA). Dept. of Computer Science. c May 1989. 139p. Sponsored by DOE/ER;OGA. DOE Contract FG02-87ER25026. (UIUCDCS-R–89-1516;UILU-ENG–89-1735). Available from Univ. of Illinois at Urbana-Champaign, 1304 W. Springfield Ave., Urbana, IL 61801-2987.

We study time parallelism for the numerical solution of nonstiff ordinary differential equations. Stability and accuracy are the two main considerations in deriving good numerical o.d.e. methods. However, existing parallel methods have poor stability properties in that their stability regions are smaller than those of good sequential methods of the same order. In this thesis we present a precise understanding of how stability limits the potential of parallelism in o.d.e.'s. We propose a fairly specific approach to construct good parallel methods – we consider zero-stable parallel methods whose stability polynomials are perfect powers of those of simple methods with good stability regions. Based on this approach we derive new efficient parallel methods. The proposed families of block methods have stability regions which do not change as the order increases. These new methods have much better stability properties than the Adams PECE methods of the same order. The above perfect power stability polynomial approach can also be extended to multi-block methods. 49 refs.

35484 (DOE/ER/25026–29) **Accuracy increase in waveform Gauss Seidel.** Juang, F.; Gear, C.W. Illinois Univ., Urbana, IL (USA). Dept. of Computer Science. Jun 1989. 27p. Sponsored by DOE Energy Research. DOE Contract FG02-87ER25026. (UILU-ENG–89-1737;UIUCDCS-R–89-1518). Order Number DE89014812/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The traditional approach for solving large dynamical systems is time consuming. Waveform relaxation, an iterative technique for solving systems of differential equations, can be used to reduce the processing time. It has been shown to converge superlinearly on finite intervals. In this paper, the order of accuracy of solutions generated by a relaxation approach, the waveform Gauss-Seidel method, is discussed. In this approach, a directed graph, called a dependency graph, is used to indicate the coupling relations among all components. The relation between the accuracy increase after each Gauss-Seidel iteration and the lengths of ascending chains (simple directed paths) in cycles in the dependency graph is discussed. It is proved that the cycle in the dependency graph which has the minimum ratio of its length to its number of ascending chains, determines the average accuracy increase. Effective use of the waveform Gauss-Seidel method depends on the ordering of the components. The result in this paper provides a basis for selecting the ordering. 2 refs.

35485 (DOE/ER/25026–30) **Safety in numbers: The boundless errors of numerical computation.** Skeel, R.D. Illinois Univ., Urbana, IL (USA). Dept. of Computer Science. Jun 1989. 9p. Sponsored by DOE Energy Research. DOE Contract FG02-87ER25026. Order Number DE89014813/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Perhaps the greatest unresolved question in numerical computing is how to cope with the issue of uncertainty in the accuracy of computed numerical quantities. The problem is not so much the errors in the answers, but the lack of a correct error bound or a confidence interval. The problem arises because of the failure to keep track of known errors and because of unknown errors due to finite sampling techniques. Several approaches to this question are discussed, principally interval analysis and probabilistic techniques. Reasons for the neglect of the uncertainty issue are suggested, and the benefits of providing consistently correct answers are considered. 13 refs.

35486 (FNAL/C–89/118) **ACP/R3000 processors in data acquisition systems.** Deppe, J.; Areti, H.; Atac, R.; Biel, J.; Cook, A.; Edel, M.; Fischler, M.; Gaines, I.; Husby, D.; Isely, M. Fermi National Accelerator Lab., Batavia, IL (USA). Feb 1989. 4p. Sponsored by DOE Energy Research. DOE Contract AC02-76CH03000. (CONF-890545–3: 6. conference on real-time computer applications in nuclear, particle and plasma physics, Williamsburg, Virginia, USA, 15-18 May 1989). Order Number DE89014811/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We describe ACP/R3000 processor based data acquisition systems for high energy physics. This VME bus compatible processor board, with a computational power equivalent to 15 VAX 11/780s or better, contains 8 Mb of memory for event buffering and has a high speed secondary bus that allows data gathering from front end electronics. 2 refs., 3 figs.

35487 (IFVE-OTF–88-110) **Programs for numerical integration of piece-wise smooth functions.** Sokolov, S.N. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij. 1988. 12p. (In Russian).

Order Number DE89620449/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A series of fortran programs for the numerical integration of piece-wise smooth functions in the one- and manydimensional spaces is described. The programs use Newton-Cotes quadrature formulas, make accuracy checks at each step, find efficiently the places of degraded smoothness (narrow peaks, splittings, breakpoints), optimize the step size and the degree of quadrature formula, assure the closeness of the actual accuracy of the result the asked one, and have improved reliability. 4 figs.

35488 (INIS-SU–74/A, pp. 86-91) **Determination of probability density on base of a finite set of integral data.** Tarasko, M.Z. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR). 1987. (In Russian). In *Methods and programs for numerical solution of the mathematical physics problems. Scientific-technical collection.* Order Number DE89012113/JAW. Available from NTIS (US Sales Only), PC A05/MF A01; INIS.

Voprosy atomnoj nauki i tekhniki.; no. 2.

Problem of determining probability of investigated physical value on the base of a finite set of integral experimental data is stated as the problem of evaluation of distribution parameters from exponential family with the maximal entropy. Algorithm description and standard program of parameters optimization are presented. 7 refs.

35489 (JINR-R–10-88-432) **Emulation of MS DOS Operational System on the Autonomous Crate-Controller with I8086 microprocessor.** Hons, Z.; Cizek, P.; Streit, V. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems. 1988. 3p. (In Russian). Order Number DE89620452/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

KM-DOS operating system for CAMAC autonomous crate-controller based on Intel 8086/8087 microprocessor connected with Pravec-16 IBM PC is described. The KM-DOS system fully emulates the MS DOS environment on the CAMAC controller. Thus ASSEMBLER, FORTRAN, C and PASCAL programs compiled and linked on IBM PC and compatible can be run on the CAMAC controller and parall work of both computers is enabled. 3 refs.; 1 tab.

35490 (LBL–25770) **SOS – Stan's Own Server: An NFS [Network File System] file server for the IBM PC.** Tan, See-Mong; Holmes, H.; Eades, C. Lawrence Berkeley Lab., CA (USA). Aug 1988. 4p. Sponsored by DOE Energy Research. DOE Contract AC03-76SF00098. Order Number DE89013412/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

SOS is a file server written to run on the IBM PC or compatibles. It conforms to Sun Microsystem's Network File System (NFS) protocol version 2. This paper discusses the SOS implementation and includes notes on portability, for programmers who wish to understand or modify it.

35491 (LBL–26700) **UCB-NE-101 user's manual.** Lee, W.W.L. Lawrence Berkeley Lab., CA (USA). Feb 1989. 14p. Sponsored by DOE Radioactive Waste Management. DOE Contract AC03-76SF00098. (UCB-NE–4135). Order Number DE89013419/JAW. Available from NTIS, PC A03/MF A01 - OSTI.

The purpose of this manual is to provide users of UCB-NE-101 with the information necessary to use UCB-NE-101 effectively. UCB-NE-101 calculates the concentration of solubility-limited species as a function of space and time and its mass flux rates from a waste sphere buried in a nuclear waste repository in water-saturated rock. The waste is surrounded by one type of rock, and some distance away, there is another type of rock. The inner layer of rock can be a backfill around a nuclear waste package and the outer layer the natural rock. The mass flux calculated is at the interface of the two layers. The species concentration calculated is in the inner layer. A constant concentration of the species, usually the solubility, is specified at the waste sphere/inner layer interface. Dissolution and transport is governed by the solubility of the species, and diffusion in the porous media. 1 ref., 1 fig.

35492 (LBL–27044) **UCB-NE-108 user's manual.** Kang, C.H.; Lee, W.W.L. Lawrence Berkeley Lab., CA (USA). Apr 1989. 9p. Sponsored by DOE Radioactive Waste Management. DOE Contract AC03-76SF00098. (UCB-NE–4143). Order Number DE89012842/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The purpose of this manual is to provide users of UCB-NE-108 with the information necessary to use UCB-NE-108 effectively. UCB-NE-108 is a computer code for calculating the fractional release rate of readily soluble radionuclides that are released from nuclear waste emplaced in water-saturated porous media, and transported through layers of porous media. Waste placed in such environments will gradually dissolve. For many species such as actinides and rare earths, the process of dissolution is governed by the exterior flow field, and the chemical reaction rate or leaching rate. In a spent-fuel waste package the soluble cesium and iodine accumulated in fuel-cladding gaps, voids, and grain boundaries of spent fuel rods are expected to dissolve rapidly when groundwater penetrates the fuel cladding. UCB-NE-108 is a code for calculating the release rate at the interface of two layers of porous material, such as the backfill around a high-level waste package and natural rock, to check compliance with the US Nuclear Regulatory Commission's (USNRC) subsystem performance objective. It is an implementation of the analytic solution given below. 6 refs., 2 figs.

35493 (ORNL/TM–11198) **Non-linear surface fitting of laser range images using a hypercube concurrent computer.** Finley, M. Oak Ridge National Lab., TN (USA). Jun 1989. 15p. Sponsored by DOE Energy Research. DOE Contract AC05-84OR21400. (CESAR–89/24). Order Number DE89013720/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Segmentation and non-linear surface fitting with laser range images are attempted on a hypercube concurrent processor. Low-level software acquires range images onto the hypercube. A substantially modified existing range image edge detector works in the hypercube image analysis environment to accomplish segmentation. The Levenberg-Marquardt algorithm implements the non-linear least squares fitting of the surfaces. Problems were found with each part of the approach. The edge detection algorithm is unnecessarily complex and yields an all to cluttered edge map. The fitting routine is limited by hardware in the number of surfaces that it can process. Finally, the fitting approach requires input estimates of the parameters which do not appear to be generalized for any image, thus keeping the process from being totally automated. Other research in surface fitting on serial computers has yielded results which may be helpful additions to solve the problems of automation. 5 refs., 8 figs.

35494 (SAND–89-0459C) **Radiation characterization of a 28C256 EEPROM.** Wrobel, T.F.; Hash, G.L.; Williams, R.J. Sandia National Labs., Albuquerque, NM (USA). 1989. 5p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890723–7: 26. annual conference on nuclear and space radiation effects, Marco Island, Florida, USA, 24-28 Jul 1989). Order Number DE89008686/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

28C256 EEPROM total dose and dose-rate results are presented. Mode dependent total dose failure occurred at 9.5 krad(Si) when writing and 33 krad(Si) when reading. Average upset and latch-up thresholds were 3.8×10^8 rad(Si)/s and 7.7×10^8 rad(Si)/s, respectively. 3 refs., 5 tabs.

35495 (SOL–89-3) **The Principal Pivoting Method revisited.** Cottle, R.W. Stanford Univ., CA (USA). Systems Optimization Lab. Apr 1989. 18p. Sponsored by DOE Energy Research. DOE Contract FG03-87ER25028. Order Number DE89013115/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The Principal Pivoting Method (PPM) for the Linear Complementarity Problem (LCP) is shown to be applicable to the class of LCPs involving the newly identified class of sufficient matrices. 10 refs.

35496 (SOL–89-4) **Note on degeneracy: Technical report.** Krishna, A.S. Stanford Univ., CA (USA). Systems Optimization Lab. Apr 1989. 4p. Sponsored by DOE Energy Research. DOE Contract FG03-87ER25028. Order Number DE89013483/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Given a linear program in standard form, Min cx s.t. $Ax = b$, $x \geq 0$, where A is an m x n matrix rational coefficients, one technique used to resolve degeneracy in the simplex algorithm is the lexicographic rule. This rule adjoins to b a non-singular m x m square

matrix M. The appended columns of M are updated along with b on each iteration. When the ratio test for determining the pivot row results in a tie, the ratio test is applied to the corresponding elements of the updated columns of M in turn, from left to right, until the tie is resolved. In this note we prove that it is only necessary instead, to adjoin to b a single column d whose ith component is $d_i = \pi^i$, (or preferably the fractional part of π^i in order that $|d_i| < 1$). Any transcendental number, like $e = 2.73\cdots$, the base of the natural logirithm, can be used instead of $\pi = 3.14\cdots$. The proof exploits the fundamental property of transcendental number namely, it can never be a root of polynomial equation $\alpha_1 x + \alpha_2 x^2 + \cdots + \alpha_p x^p = 0$ when $\alpha_1, \alpha_2, \cdots, \alpha_p$ are rational and not all zero.

35497 (SOL–89-5) **An efficient exact algorithm for the "least squares" image registration problems.** Zikan, K. Stanford Univ., CA (USA). Systems Optimization Lab. May 1989. 14p. Sponsored by DOE Energy Research. DOE Contract FG03-87ER25028. Order Number DE89013116/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Image registration involves estimating how one set of n-dimensional points is rotated, scaled, and translates into a second set of n- dimensional points. In practice, n is usually 2 or 3. We give an exact algorithm to solve the "least-squares" formulation of the two-dimensional registration problem. The algorithm, which is based on parametric linear programming, can be viewed as a refinement of the $O(k^3)$ approximation method proposed by Zikan and Silberburg. The approach can be extended to handle registration of images of different cardinalities. 13 refs., 1 fig.

35498 (UCID–21656) **Proposal for a code development and maintenance environment.** Young, J. Lawrence Livermore National Lab., CA (USA). 17 Apr 1989. 13p. Sponsored by DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE89013380/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This paper discusses methods of improving software development. 3 refs., 6 figs.

35499 (UCRL–98149) **Monotone piecewise cubic data fitting.** Fritsch, F.N. Lawrence Livermore National Lab., CA (USA). Jul 1988. 8p. Sponsored by DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-890742–1: 2. Shrivenham international conference on algorithms for approximation, Shrivenham, UK, 12-15 Jul 1989). Order Number DE89006742/JAW. Available from NTIS, PC A02/MF A01 - OSTI.

This paper describes PCHLS, an algorithm for least squares fitting of a monotone piecewise cubic function to data. It extends the piecewise cubic Hermite interpolation package PCHIP to situations in which the data are noisy or are adequately represented by far fewer cubic pieces than data points. 6 refs., 5 figs.

35500 (UCRL–101076) **LLNL's plan for a prototype circuit switch, a potential gigabit LAN of the future.** Rupert, P.R. Lawrence Livermore National Lab., CA (USA). Apr 1989. 6p. Sponsored by DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-8904210–4: Cray user's group conference, Los Angeles, California, USA, 24-28 Apr 1989). Order Number DE89013147/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

LLNL's High Speed Communication Project will prototype a communications system designed to foster distributed computing and to provide visualization from our Supercomputers to our Scientists and Engineers. High Quality graphics images require 24 MBits per frame and 750 MBits/sec for animation; we fully anticipate that the next generation of Supercomputers will provide animated results for general users. Local visualization machines will be available for rendering and graphics manipulation, but visualization of meaningful physics will require communications of large blocks of computed results between Supercomputers and local devices. In addition to visualization, we are developing a distributed computing environment. The required transfer of data between Supercomputers and other local mini-Supers or special purpose floating point accelerators, will sorely tax our existing communications ability. Improved communications mechanisms will be necessary before distributed applications can become truly effective. This paper describes our plans to demonstrate, through the use of a prototype system, data transmission at 800 MBits/sec per channel and aggregate bandwidth growth that is linear with the number of connected users and computers. 3 figs.

35501 (WSRC-RP–89-123) **The Savannah River Site local area network.** Johnson, A.J. Westinghouse Savannah River Co., Aiken, SC (USA). 1989. 13p. Sponsored by DOE Defense Programs. DOE Contract AC09-89SR18035. (CONF-8906124–1: Meeting of the Association of Energy Systems Operations and Programming, Morgantown, West Virginia, USA, 6-9 Jun 1989). Order Number DE89013554/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The Savannah River Site (SRS) consists of thirteen separate operating or administrative facilities, or areas, spread out over 300 square miles of federal reservation. A facility of this size presents rather unique difficulties to anyone attempting to provide a comprehensive and high performance computer network, or local area network (LAN). Figure 1 is a diagram of the SRS and indicates the approximate number of "knowledge workers" (i.e., managerial, professional, and clerical staff) which are located in each site area. The goal of the SRS LAN project is to have each of these workers connected to and using the computer network by the end of 1990. By mid 1989 SRS is three quarters of the way to completing this goal. The fundamental LAN strategy for Savannah River is the integration of personal computers with mid size "departmental" computers located within each site area with links to the site's mainframe computer systems and offsite databases for information access. This integration is being provided by baseband local area networks in each of the site areas adjoined together via a broadband and digital telephone communications system to form one sitewide internetwork. The site internetwork is used to connect the departmental and mainframe computers together as well as provide workstation to computer access between site areas. 6 figs.

35502 **A high dynamic range acousto-optic image correlator for real-time pattern recognition.** Molley, P.A. (Sandia National Labs., Albuquerque, NM (US)); Stalker, K.T. v.v of Digital and optical shape representation and pattern recognition. Juday, R.D. SPIE Society of Photo-Optical Instrumentation Engineers, Bellingham, WA (1988). (CONF-8804230–: Digital and optical shape representation and pattern recognition, Orlando, Florida, USA, 4-6 Apr 1988).

The architecture and experimental results for an incoherent acousto-optic image correlator suitable for real-time applications are presented. In the basic architecture, each time a line of the raster-scanned input image is fed into the acousto-optic device (AOD), all rows of a digitally stored reference image are read into the system using an array of light emitting diodes (LEDs). Thus, the required two-dimensional correlation is performed as a series of multi-channel 1-D time-integrations in x (performed in the AOD) combined with a multi-channel correlation in y (perpendicular to the AOD axis) using a modified CCD. The LED array and detector modifications which markedly increase the dynamic range are discussed as well as the correlator design. Further, a novel memory for storing the reference object is described for rapidly changing templates. Experimental results indicate the architecture is useful for applications in the areas of character recognition and target identification.

35503 **Artificial intelligence and real-time optimization.** Wong, C. (Lawrence Livermore National Lab., Livermore, CA (US)). v.v of Proceedings of the 24th Eastern Analytical Symposium, Inc. Litarvin Literature, Arvada, CO (1987). (CONF-861009–: Silver Jubilee Eastern Analytical symposium, New York, New York, USA, 20-24 Oct 1986).

The ability to optimize instrument operational and data acquisition parameters while actually running an experiment has a number of advantages. If there are vast amounts of complex data, as from a triple quadrupole mass spectrometer (TQMS), selective data optimization, acquisition, and information enhancement are achieved. A good example of this is determination of trace sulfur gas species in the pyrolysis gas of an oil shale retort using an on-line TQMS. Traditionally, tuning parameters for the sulfur gas analysis are manually determined by an expert operator of the TQMS. A particular parent-daughter pair, representative of a mass range which includes most of the sulfur gases of interest, is chosen. Typically, this would be daughter 32 from parent 60 of carbonyl sulfide. However, recent

studies have shown that the optimum tuning for COS, is not the optimum for carbon disulfide (daughter 32 of parent 76), or ethanethiol (daughter 20 from parent 62), even though both the parent and daughter ions for these compounds are very close in molecular weight and the compounds all contain sulfur. In fact, just one tuning parameter, the collision energy, if optimized for COS, resulting in a 50% loss in intensity for CS2 or ethanethiol. Given the number of parameters to be tuned, manual tuning for each compound is simply not cost effective. Therefore, an expert system has been developed which enables the instrument to be optimized for the various gases based on rules associated with peak shape, intensity, resolution, interactions between tuning parameters and compound and mass differences.

35504 Analysis of binarized Hartley phase-only filter performance with respect to stochastic noise. Dickey, F.M. (Sandia National Labs., Albuquerque, NM (US)); Mason, J.J.; Stalker, K.T. v.v of Digital and optical shape representation and pattern recognition. Juday, R.D. SPIE Society of Photo-Optical Instrumentation Engineers, Bellingham, WA (1988). (CONF-8804230–: Digital and optical shape representation and pattern recognition, Orlando, Florida, USA, 4-6 Apr 1988).

Binary phase-only filters (BPOF) are a viable candidate for the replacement of matched filters in real-time image processing and pattern recognition applications. The original BPOFs were binarized versions of the real or imaginary parts of the Fourier transform. Recently, a filter has been proposed which is the binarized Hartley transform. In this paper, the noise performance of the binarized Hartley phase-only filter is analyzed and compared to other BPOFs as well as the phase-only and matched filter. It is well known that the matched filter optimizes signal-to-noise ratio. Further, it can be shown that the matched filter phase is the optimum phase-only filter. A bound on the BPOF signal-to-noise ratio relative to that of the phase-only filter is derived. Finally, the analysis is applied to the generalized form of the binarized Hartley transform.

35505 Simulated annealing in networks for computing possible arrangements for red and green cones. Ahumada, A.J. Jr. (NASA Ames Research Center (US)). v.v of Proceedings of the IEEE first international conference on neural networks. Volumes 1-4. Caudill, M.; Butler, C. IEEE Service Center, Piscataway, NJ (1987). (CONF-8706130–: 1. IEEE international conference on neural networks, San Diego, California, USA, 21-24 Jun 1987).

The packing arrangement of the cones in the central fovea has been carefully measured in retinal preparations from monkeys. Psychophysical measurements have been made using laser interferometry in humans. Although these measurements are indirect, they are free from possible histological artifacts. The psychophysical techniques for observing the arrangement are based on the moire patterns which are perceived when very fine gratings are imaged on the retina by laser interferometry. The results of the technique depend on the regularity of the cone array. In the center of the fovea, where the cones can be very regularly packed, the moire pattern is fairly regular and the technique gives both the orientation and the spacing of the cone array. In the center of the fovea, there are very few blue cones, so they are ignored here and only the red and green ones are considered. The arrangement of the red or green cones alone is now known. There is no definitive information about the relative number of red and greens in the central fovea, although there is indirect evidence indicating that there are twice as many red cones as green cones.

35506 Massively parallel mathematical sieves. Montry, G.R. (Sandia National Labs., Albuquerque, NM (US)). *International Journal of Supercomputer Application (USA)*, 3(1): 59-74 (1989).

The Sieve of Eratosthenes is a well-known algorithm for finding all prime numbers in a given subset of integers. A parallel version of the Sieve is described that produces computational speedups over 800 on a hypercube with 1,024 processing elements for problems of fixed size. Computational speedups as high as 980 are achieved when the problem size per processor is fixed. The method of parallelization generalizes to other sieves and will be efficient on any ensemble architecture. We investigate two highly parallel sieves using scattered decomposition and compare their performance on a hypercube multiprocessor. A comparison of different parallelization techniques for the sieve illustrates the trade-offs necessary in the design and implementation of massively parallel algorithms for large ensemble computers.

9903 Information Handling

Refer also to citation(s) 33261, 33531, 33717, 34406, 34706

35507 (ESC-WR–89-01) **Restricted feasibility study on conversion of the EDN system to the Cyber-computer.** Roemer, J.C.; Warmer, C.J. Stichting Energieonderzoek Centrum Nederland, Petten (Netherlands). Energie Studie Centrum. Feb 1989. 45p. (In Dutch). Available from Netherlands Energy Research Foundation ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

The Energy Databank Netherlands (EDN) functions since 1987 as a referential databank for numerical energy related data in the Netherlands. The databank works on a personal computer and questions to the system are answered by an intermediary. The supported committee EDN suggested in one of her meetings (Feb. 5th, 1988) to come to a better use of the present databank. One of the suggestions was to determine the interest for a directly accessible EDN on a mainframe computer (Cyber). The results of an inquiry held amongst subscribers, users and interested people are presented and discussed. The technical possibilities at ENR (computer centre of the Netherlands Energy Research Foundation) and the necessary operations to transfer the EDN to the Cyber are discussed too. It is concluded that a directly accessible EDN with numerical data is favorite. Transfer of the present EDN to the Cyber is technically seen no problem. The input of the numerical data however will be very labor-intensive. 9 tabs., 2 apps.

35508 Improved cassette recording of multichannel analyzer data. Latner, N. (Environmental Measurements Laboratory, New York, NY (USA)); Chiu, N. *Health Physics (USA)*, 56(4): 561-563 (Apr 1989).

As part of a field experiment, five of these modified tape decks with associated MCAs have been operating successfully for several months in an essentially unattended mode. In addition, this automatic system facilitates readout during attended operation by eliminating the need to press keys. Tapes generated on these decks are totally compatible and interchangeable with those made by the manual cassette unit.

9905 Civilian Defense

35509 (SAND–89-0192) **Recommended baseline direct-strike lightning environment for stockpile-to-target sequences.** Fisher, R.J.; Uman, M.A. Sandia National Labs., Albuquerque, NM (USA). May 1989. 18p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. Order Number DE89012879/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The lightning literature extant through the end of 1988 has been reviewed and used to develop an updated generic, or baseline, direct-strike lightning environment for nuclear weapon Stockpile-to-Target Sequence documents. The supporting rationale for recommended changes is given, along with a discussion of the interpretation of the environment for weapon nuclear safety assessment. 13 refs., 2 tabs.

35510 (SAND–89-0289C) **Z-pinch experiments on Saturn at 30 TW.** Spielman, R.B.; Dukart, R.J.; Hanson, D.L.; Hammel, B.A.; Hsing, W.W.; Matzen, M.K.; Porter, J.L. Sandia National Labs., Albuquerque, NM (USA). 1989. 14p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-8904107–3: 2. international conference on high-density pinches (ICHDP-2), Laguna Beach, California, USA, 26-28 Apr 1989). Order Number DE89013497/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

We have recently completed the first gas-puff z-pinch on Saturn (32 TW, 1.4 MJ, 1.9 MV, 40-ns FWHM, and 0.11 Ω). These experiments used the most powerful driver to date for fast z-pinch experiments. Saturn, a 36 module accelerator, uses a double post-hole vacuum convolute to deliver the total machine current to the load. The 10-nH Saturn z-pinch diode is capable of delivering a peak current of 10.5 MA. We diagnosed the current using segmented Rogowski coils at the insulator, resistive shunts in the

vacuum transmission lines, and B-dot loops and piezoelectric pressure gauges near the load. On most shots electrical losses in the vacuum convolute were minimal with nearly complete current delivery to the z-pinch load. We have conducted experiments with deuterium, neon, argon, krypton, and xenon gas puffs. A maximum total radiation yield of 505 ± 25 kJ was obtained with xenon. The peak keV x-ray yields were 100 ± 5 kJ for neon K-shell radiation, 30 ± 4 kJ for krypton L-shell radiation, and 39 ± 4 kJ for argon K-shell radiation. 12 refs., 15 figs., 2 tabs.

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	14:34227	SAND–89-0071C
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	14:34306	SAND–88-3335C
	14:34307	SAND–88-3427C

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	14:34308	SAND–89-0299C
	14:34360	SAND–89-0379C
	14:34366	SAND–89-0589C
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	14:34370	SAND–88-3239C
	14:34371	SAND–89-0090C
	14:35297	SAND–89-7082C
	14:35464	SAND–88-3238C
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	14:35466	SAND–89-0274C
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	14:35510	SAND–89-0289C
	14:33230	CONF-890631–45
	14:33334	SAND–89-1114C
	USDOE Pittsburgh Energy Technology Center, PA (USA)	
	14:33061	CONF-8810170–
	Nuclear Regulatory Commission, Washington, DC (USA). Div. of Systems Research	
	14:33592	NUREG/CR–5193
	14:33926	Published article
	14:33932	Published article
	14:33975	Published article
	14:34088	Published article
AC04-76DP03533	**Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant**	
	14:33290	RFP–4302
	14:34063	RFP–4317
	14:34128	RFP-Trans–499
AC04-88DP43495	**EG and G Mound Applied Technologies, Miamisburg, OH (USA)**	
	14:34060	MLM–3594
AC05-76OR00001	**Martin Marietta Energy Systems, Inc., Piketon, OH (USA)**	
	14:33289	POEF-A–355
AC05-81OR20722	**Bechtel National, Inc., Oak Ridge, TN (USA)**	
	14:33258	DOE/OR/20722–208
AC05-84ER40150	**Southeastern Universities Research Association, Newport News, VA (USA). Continuous Electron Beam Accelerator Facility**	
	14:34281	DOE/ER/40150–69
AC05-84OR21400	**Oak Ridge National Lab., TN (USA)**	
	14:33947	CONF-890720–1
	14:34727	CONF-890702–1
	14:33040	CONF-890666–1
	14:33231	CONF-890631–49
	14:33256	CONF-890619–2
	14:33287	ORNL/TM–11037
	14:33450	CONF-890555–17
	14:33451	CONF-890781–1
	14:33452	CONF-890781–2
	14:33518	ORNL–6546
	14:33542	ORNL–6539
	14:33560	ORNL/TM–11187
	14:33569	CONF-890782–1
	14:33612	CONF-890421–9
	14:33716	CONF-890609–4
	14:33754	DOE/OR/21400–T352
	14:33812	CONF-890721–9
	14:33813	CONF-890748–3
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	14:33818	CONF-8905118–12
	14:33946	CONF-890653–1
	14:33976	CONF-890426–16
	14:33977	CONF-890627–1
	14:34052	CONF-8810133–6
	14:34061	ORNL–6547
	14:34062	ORNL/FTR–3268
	14:34118	CONF-890721–5
	14:34461	CONF-890526–1
	14:34463	ORNL/TM–11108
	14:34491	ORNL/FTR–3273
	14:34670	CONF-890517–2
	14:34701	ORNL/FTR–3051
	14:34702	ORNL/FTR–3260
	14:34706	CONF-881249–4
	14:34707	ORNL/TM–11195
	14:34896	CONF-890703–7
	14:34911	ORNL/FTR–3265
	14:35040	ORNL/FTR–3266
	14:35090	CONF-8901120–3
	14:35162	ORNL/FTR–3277
	14:35199	ORNL/FTR–3278
	14:35404	CONF-8905120–16
	14:35405	CONF-8905120–17
	14:35425	ORNL/TM–11102
	14:35493	ORNL/TM–11198
	14:33101	ORNL/Sub–83-43346/03
	14:33433	ORNL/Sub–87-86004/5
	14:33755	DOE/OR/21400–T357
	Sandia National Labs., Albuquerque, NM (USA)	
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	Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering	
	14:33285	NUREG/CR–5235
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	USDOE Pittsburgh Energy Technology Center, PA (USA)	
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	14:33938	Published article
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	14:33970	Published article
	14:34519	Published article
	14:34924	Published article
	14:35062	Published article
	14:35095	Published article
AC05-84OS21400	**Oak Ridge Y-12 Plant, TN (USA)**	
	14:34139	Y–2405
AC05-84OT21400	**Oak Ridge Gaseous Diffusion Plant, TN (USA)**	
	14:33277	K/QT–301
	14:34123	K/SS–528
AC05-86OR21548	**MK-Ferguson Co., St. Charles, MO (USA)**	
	14:33328	DOE/OR/21548–046-Rev.1
AC06-76RL01830	**General Electric Co., Richland, WA (USA). Hanford Atomic Products Operation**	
	14:33266	HW–28121
	14:33571	HW–33452
	Sandia National Labs., Albuquerque, NM (USA)	
	14:33493	SAND–88-1761C
	14:33230	CONF-890631–45
	Pacific Northwest Lab., Richland, WA (USA)	
	14:33288	PNL–6874
	14:34425	PNL–6910
	14:34629	PNL–6250
	USDOE Pittsburgh Energy Technology Center, PA (USA)	
	14:33116	CONF-8810170–

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	14:34209	Published article
AC06-87RL10930	Westinghouse Hanford Co., Richland, WA (USA)	
	14:33314	WHC-SA-0426
	14:33315	WHC-SA-0570
	14:33561	WHC-EP-0259
AC07-76ID01570	EG and G Idaho, Inc., Idaho Falls, ID (USA)	
	14:33264	EGG-M-13387
	Sandia National Labs., Albuquerque, NM (USA)	
	14:33230	CONF-890631-45
AC07-81NE44139	West Valley Nuclear Services Co., Inc., West Valley, NY (USA)	
	14:33257	DOE/NE/44139-40
AC08-80DP40130	Avco-Everett Research Lab., Everett, MA (USA)	
	14:34146	DOE/DP/40130-2
AC08-80DP40131	Physics International Co., San Leandro, CA (USA)	
	14:35444	DOE/DP/40131-02
	14:35445	DOE/DP/40131-04
AC08-84NV10322	Fenix and Scisson, Inc., Mercury, NV (USA)	
	14:34120	DOE/NV/10322-36
AC08-86NV10571	Lockheed Missiles and Space Co., Inc., Palo Alto, CA (USA). Research and Development Div.	
	14:34899	DOE/NV/10571-T2
AC08-87NV10576	Science Applications International Corp., Las Vegas, NV (USA)	
	14:33254	CONF-890207-33
AC09-76SR00001	Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.	
	14:33756	DOE-tr-118
	14:34715	DPSTOM-81
	Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant	
	14:33263	DPST-88-626
	Savannah River Lab., Aiken, SC (USA)	
	14:34457	DP-MS-88-62
	14:34488	DPST-86-801
AC09-89SR18035	Savannah River Lab., Aiken, SC (USA)	
	14:34138	WSRC-RP-89-61
	Westinghouse Savannah River Co., Aiken, SC (USA)	
	14:33316	WSRC-RP-89-145
	14:35501	WSRC-RP-89-123
AC12-76SN00052	Knolls Atomic Power Lab., Schenectady, NY (USA)	
	14:34505	KAPL-4709
AC21-85MC22184	Tennessee Univ., Tullahoma, TN (USA). Space Inst.	
	14:34362	DOE/MC/22184-2661
AC21-86MC22134	Foster Wheeler USA Corp., Clinton, NJ (USA)	
	14:33211	DOE/MC/22134-2698
AC21-86MC23258	Adiabatics, Inc., Columbus, IN (USA)	
	14:33780	DOE/MC/23258-2693
AC21-87MC23287	United Technologies Research Center, East Hartford, CT (USA)	
	14:33341	DOE/MC/23287-2657
AC21-87MC24160	Research Triangle Inst., Research Triangle Park, NC (USA)	
	14:33127	DOE/MC/24160-2671
AC21-87MC24267	North Dakota Univ., Grand Forks, ND (USA). Energy and Mineral Research Center	
	14:33065	DOE/MC/24267-2665
AC22-82PC50041	USDOE Pittsburgh Energy Technology Center, PA (USA)	
	14:33049	CONF-8810170-
AC22-83PC63032	TRW Space and Technology Group, Redondo Beach, CA (USA). Applied Technology Div.	
	14:33066	DOE/PC/63032-T19
AC22-84PC70002	USDOE Pittsburgh Energy Technology Center, PA (USA)	
	14:33044	CONF-8810170-
AC22-84PC70018	Consolidation Coal Co., Library, PA (USA). Research and Development Dept.	
	14:33041	CONF-8711252-1
	14:33062	CONF-8810170-4
	14:33166	CONF-880604-17
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	USDOE Pittsburgh Energy Technology Center, PA (USA)	
	14:33115	CONF-8810170-
AC22-85PC80014	Lehigh Univ., Bethlehem, PA (USA). Dept. of Chemistry	
	14:33358	DOE/PC/80014-T1
AC22-85PC80015	Massachusetts Inst. of Tech., Cambridge, MA (USA). Dept. of Chemical Engineering	
	14:33349	DOE/PC/80015-T4
AC22-85PC81002	Cottrell Environmental Sciences, Somerville, NJ (USA)	
	14:33437	DOE/PC/81002-T20
AC22-85PC81012	Dravo Lime Co., Pittsburgh, PA (USA)	
	14:33438	DOE/PC/81012-T1-Pt.1-B
	14:33439	DOE/PC/81012-T1-Pt.3
	14:33440	DOE/PC/81012-T1-Pt.4
	14:33441	DOE/PC/81012-T1-Pt.5
AC22-86PC90013	Union Carbide Corp., South Charleston, WV (USA)	
	14:33359	DOE/PC/90013-T8
AC22-87PC79668	Westinghouse Electric Corp., Pittsburgh, PA (USA). Advanced Energy Systems Div.	
	14:34379	DOE/PC/79668-T3
AC22-87PC79670	Babcock and Wilcox Co., Alliance, OH (USA). Research and Development Div.	
	14:33681	DOE/PC/79670-1
	14:33682	DOE/PC/79670-2
	14:33683	DOE/PC/79670-3
	14:33684	DOE/PC/79670-4
AC22-87PC79671	Tennessee Univ., Tullahoma, TN (USA). Space Inst.	
	14:33685	DOE/PC/79671-T1
AC22-87PC79672	TRW Space and Technology Group, Redondo Beach, CA (USA). Applied Technology Div.	
	14:33686	DOE/PC/79672-T2
AC22-87PC79818	USDOE Pittsburgh Energy Technology Center, PA (USA)	
	14:33044	CONF-8810170-
AC22-87PC79936	USDOE Pittsburgh Energy Technology Center, PA (USA)	
	14:33052	CONF-8810170-
AC22-88PC79815	Michigan Biotechnology Inst., Lansing, MI (USA)	
	14:33068	DOE/PC/79815-T1
AC22-88PC88810	National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)	
	14:33070	DOE/PC/88810-1
AC22-88PC88811	USDOE Pittsburgh Energy Technology Center, PA (USA)	
	14:33071	DOE/PC/88811-T1
AC22-88PC88812	Colorado School of Mines, Golden, CO (USA). Dept. of Chemical Engineering and Petroleum Refining	
	14:33072	DOE/PC/88812-T2

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AC22-88PC88813	Western Research Inst., Laramie, WY (USA)	
	14:33073	DOE/PC/88813–T2
AC22-88PC88814	Advanced Fuel Research, Inc., East Hartford, CT (USA)	
	14:33074	DOE/PC/88814–T2
AC22-88PC88817	Utah Univ., Salt Lake City, UT (USA). Dept. of Fuels Engineering	
	14:33075	DOE/PC/88817–T1
	14:33076	DOE/PC/88817–T2
AC79-86BP60288	ADM Associates, Inc., Sacramento, CA (USA)	
	14:33720	DOE/BP/60288–3
AC79-88BP39166	Northwest Economic Associates, Vancouver, WA (USA)	
	14:33753	DOE/BP/39166–1
AI01-87ER30107	National Acid Precipitation Assessment Program, Washington, DC (USA). Office of the Director	
	14:34383	DOE/ER/30107–T1
AI08-78ET44802	Nevada Bureau of Mines and Geology, Reno, NV (USA)	
	14:34728	DOE/ET/44802–T23
AI08-87NV10566	National Oceanic and Atmospheric Administration, Las Vegas, NV (USA). Weather Service Nuclear Support Office	
	14:34374	NVO–329
	14:34375	NVO–330
	14:34376	NVO–331
	14:34377	NVO–332
AI21-83MC20422	Geological Survey, Menlo Park, CA (USA)	
	14:33186	DOE/MC/20422–2691
	14:33187	DOE/MC/20422–2692
AI79-83BP12921	USDOE Bonneville Power Administration, Portland, OR (USA)	
	14:33718	DOE/BP/12921–4-Vol.1
	14:33719	DOE/BP/12921–5-Vol.2-App.
AI79-84BP16726	Forest Service, Corvallis, OR (USA). Forestry Sciences Lab.	
	14:33377	DOE/BP/16726–4
AI79-84BP17622	Confederated Tribes of the Umatilla Indian Reservation, Pendleton, OR (USA)	
	14:33378	DOE/BP/17622–2
AI79-86BP64355	Portland State Univ., OR (USA)	
	14:33721	DOE/BP/64355–1
AI79-87BP36834	National Fisheries Research Center-Great Lakes, Ann Arbor, MI (USA)	
	14:33379	DOE/BP/36834–1
AP07-89ID10333	Technology Prospects, Inc., Falls Church, VA (USA)	
	14:33422	DOE/ID/10333–T1
	14:34958	Published article
	14:35236	Published article
	14:33131	Published article
FC07-80ID12118	Spokane Dept. of Water and Hydroelectric Services, WA (USA)	
	14:33371	DOE/ID/12118–2
FC22-83FE60149	National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)	
	14:33178	NIPER–82
	14:33179	NIPER–415
FC22-88PC79808	West Virginia Univ., Morgantown, WV (USA). Dept. of Chemical Engineering	
	14:33067	DOE/PC/79808–T1
FC22-89PC88750	TRW Energy Products Group, Redondo Beach, CA (USA). Combustion Business Unit	
	14:33430	DOE/PC/88750–T1
FG01-84NE34122	Studsvik Energiteknik AB, Nykoeping (Sweden)	
	14:33475	STUDSVIK-STSRX–5
	14:33476	STUDSVIK-STSRX–6
	14:33506	STUDSVIK-STSRX–8
FG02-84ER13243	Saint John Fisher Coll., Rochester, NY (USA)	
	14:34897	DOE/ER/13243–5
FG02-84ER45080	Northwestern Univ., Evanston, IL (USA). Dept. of Physics and Astronomy	
	14:33846	DOE/ER/45080–T3
FG02-84ER53175	Missouri Univ., Rolla, MO (USA)	
	14:35407	DOE/ER/53175–T1
FG02-85ER13369	Michigan State Univ., East Lansing, MI (USA)	
	14:33384	DOE/ER/13369–4
FG02-85ER13396	Carnegie-Mellon Univ., Pittsburgh, PA (USA)	
	14:34119	DOE/ER/13396–T1
FG02-85ER13404	Minnesota Univ., Minneapolis, MN (USA). Dept. of Chemistry	
	14:34095	DOE/ER/13404–4
FG02-85ER45213	Pittsburgh Univ., PA (USA). Dept. of Materials Science and Engineering	
	14:33847	DOE/ER/45213–6
FG02-86ER13552	Clarkson Univ., Potsdam, NY (USA)	
	14:34053	DOE/ER/13552–T1
FG02-86ER45265	Queens Coll., Flushing, NY (USA). Dept. of Physics	
	14:35201	DOE/ER/45265–T3
FG02-86ER53227	Wisconsin Univ., Madison, WI (USA). Plasma Physics Research	
	14:35408	DOE/ER/53227–134
FG02-87ER13774	Pittsburgh Univ., PA (USA). Dept. of Chemistry	
	14:34070	DOE/ER/13774–T1
FG02-87ER25026	Illinois Univ., Urbana, IL (USA). Dept. of Computer Science	
	14:35483	DOE/ER/25026–28
	14:35484	DOE/ER/25026–29
	14:35485	DOE/ER/25026–30
FG02-87ER60502	Vermont Univ., Burlington, VT (USA)	
	14:34671	DOE/ER/60502–03
FG02-88DP48058	Virginia Polytechnic Inst. and State Univ., Blacksburg, VA (USA). Management Systems Labs.	
	14:33661	DOE/DP/48058–1
FG02-88ER13880	Missouri Univ., Columbia, MO (USA)	
	14:34071	DOE/ER/13880–1
FG03-87ER25028	Stanford Univ., CA (USA). Systems Optimization Lab.	
	14:35495	SOL–89-3
	14:35496	SOL–89-4
	14:35497	SOL–89-5
FG05-85ER13394	Virginia Univ., Charlottesville, VA (USA). Dept. of Physics	
	14:34898	DOE/ER/13394–4
FG05-86ER13461	Maryland Univ., College Park, MD (USA). Dept. of Botany	
	14:34517	DOE/ER/13461–3
FG05-86ER40272	Florida Univ., Gainesville, FL (USA)	
	14:34319	CONF-890379–6
FG05-87ER40319	Florida State Univ., Tallahassee, FL (USA). Dept. of Physics	
	14:34943	DOE/ER/40319–3-Pt.1.
	14:34961	DOE/ER/40319–3-Pt.2
FG05-87ER52147	Maryland Univ., College Park, MD (USA)	
	14:34147	DOE/ER/52147–2
FG05-87ER54034	National Research Council, Washington, DC (USA). Committee on Magnetic Fusion in Energy Policy	
	14:35424	NRC–9012959

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	14:33131	Published article
	14:34928	Published article
	14:34958	Published article
FG06-80ET34032	**Studsvik Energiteknik AB, Nykoeping (Sweden)**	
	14:33463	STUDSVIK-STSR-4
	14:33464	STUDSVIK-STSR-14
	14:33465	STUDSVIK-STSR-15
	14:33466	STUDSVIK-STSR-22
	14:33467	STUDSVIK-STSR-25
	14:33468	STUDSVIK-STSR-26
	14:33469	STUDSVIK-STSR-27
	14:33470	STUDSVIK-STSR-28
	14:33472	STUDSVIK-STSR-30
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	14:33474	STUDSVIK-STSR-32
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	14:33504	STUDSVIK-STSR-18
	14:33505	STUDSVIK-STSR-20
	14:33543	STUDSVIK-STSR-8
	14:33471	STUDSVIK-STSR-29
	14:33497	STUDSVIK-STSR-5
	14:33501	STUDSVIK-STSR-10
FG06-87ER13796	**Washington State Univ., Pullman, WA (USA)**	
	14:34717	DOE/ER/13796-6
	Washington State Univ., Pullman, WA (USA). Dept. of Geology	
	14:34716	DOE/ER/13796-2
	14:34502	Published article
FG22-84PC70780	**Delaware Univ., Newark, DE (USA). Dept. of Chemical Engineering**	
	14:33357	DOE/PC/70780-T10
FG22-84PC70808	**USDOE Pittsburgh Energy Technology Center, PA (USA)**	
	14:33058	CONF-8810170-
FG22-86PC90538	**Wyoming Univ., Laramie, WY (USA). Dept. of Chemical Engineering**	
	14:33077	DOE/PC/90538-11
FG22-86PC90959	**Duke Univ., Durham, NC (USA). Dept. of Civil and Environmental Engineering**	
	14:33135	DOE/PC/90959-T9
FG22-87BC14126	**Stanford Univ., CA (USA). Petroleum Research Inst.**	
	14:33154	DOE/BC/14126-7
	14:33160	DOE/BC/14126-8
FG22-87PC79806	**USDOE Pittsburgh Energy Technology Center, PA (USA)**	
	14:33032	CONF-8810170-
FG22-87PC79925	**Lehigh Univ., Bethlehem, PA (USA). Dept. of Chemistry**	
	14:33120	DOE/PC/79925-5
FG22-87PC79928	**Pittsburgh Univ., PA (USA). Dept. of Chemical and Petroleum Engineering**	
	14:33069	DOE/PC/79928-T7
FG22-88PC88941	**West Virginia Univ., Morgantown, WV (USA). Dept. of Mechanical and Aerospace Engineering**	
	14:33121	DOE/PC/88941-T2
	14:33519	Published article
	14:33942	Published article
	14:34043	Published article
	14:34921	Published article
	14:34938	Published article
	14:34958	Published article
	14:35063	Published article
	14:35080	Published article
	14:35236	Published article
W-31109-ENG-38	**Argonne National Lab., IL (USA)**	
	14:33137	CONF-890402-7
	14:33255	CONF-890421-10
	14:33511	ANL-FRA-163
	14:33512	ANL-FRA-164
	14:33565	CONF-890103-10
	14:33611	ANL-89/4
	14:33809	CONF-890426-20
	14:33810	CONF-890468-9
	14:33811	CONF-890468-10
	14:33945	CONF-890216-2
	14:33948	CONF-8810117-2
	14:34239	CONF-890335-200
	14:34278	CONF-890335-211
	14:34318	ANL-HEP-CP-89-48
	14:34895	CONF-890586-1
	14:34930	CONF-8810118-9
	14:34942	ANL-HEP-CP-89-50
	14:34946	ANL-HEP-CP-89-40
	14:35003	ANL-HEP-PR-87-54
	14:35443	CONF-8904215-3
	Argonne National Lab., IL (USA). High Energy Physics Div.	
	14:34237	ANL-HEP-PR-89-45
	Sandia National Labs., Albuquerque, NM (USA)	
	14:33493	SAND-88-1761C
	14:33334	SAND-89-1114C
W-7405-ENG-36	**Los Alamos National Lab., NM (USA)**	
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	14:33333	LA-UR-89-1862
	14:33517	LA-UR-89-1772
	14:33800	LA-UR-89-1000
	14:34125	LA-UR-89-5
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	14:33312	UCID-21466
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	14:34150	SPIE Society of Photo-Optical Instrumentation Engineers, 1022 19 St., P.O. Box 10, Bellingham, WA 98227			
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	14:33964	American Ceramic Society Inc., 757 Brooksedge Plaza Drive, Westerville, OK 43081-2821			
CONF-8609223–		(ECFA workshop: LEP 200; Aachen, Germany, F.R.; 29 Sep - 1 oct 1986)			
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	14:33908	Materials Research Society, 9800 Mc Knight Rd., Suite 327, Pittsburgh, PA 15237			
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	14:33354	Illinois Dept. of Energy and Natural Resources, 325 West Adams, Room 300, Springfield, IL 62706			

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CONF-8705378–		(Erice school on physics witts low-energy antiprotons; Erice, Italy; May 1987)			
	14:34944	*See* ISN–87-97			
CONF-870636–		(5. national congress on pressure vessels and piping; San Diego, California, USA; 28 Jun - 2 jul 1987)			
	14:34174	American Society of Mechanical Engineers, 345 East 47 St., New York, NY 10017			
CONF-8706387–		(22. JOWOG meeting; Livermore, California, USA; 9-11 Jun 1987)			
	14:33814	NTIS, PC A22/MF A01 - OSTI		DE89013004/JAW	MF-700
CONF-8706397–		(Final research co-ordination meeting on application of radiation technology in immobilization of bioactive materials; Beijing, China; 15-18 Jun 1987)			
	14:33350	*See* IAEA-TECDOC–486			
CONF-8707107–		(1. international conference on laser M2P; Lyon-Villeurbanne, France; 7-9 Jul 1987)			
	14:34049	*See* CEA-CONF–9289			
CONF-8707174–		(Rencontre on the hidden mass and the dark matter; Annecy, France; 8-10 Jul 1987)			
	14:34862	*See* LAPP-TH–206-87			
CONF-8707208–		(U.S. Particle Accelerator School: physics of particle accelerators; Batavia, Illinois, USA; 20 Jul - 14 aug 1987)			
	14:34236				
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	14:34316				
CONF-8707216–		(32. Annual conference of the South African Institute of Physics; Durban, South Africa; 13-17 Jul 1987)			
	14:35127	*See* INIS-mf–11396			
CONF-8708101–		(6. international symposium on capture gamma-ray spectroscopy; Leuven, Belgium; 31 Aug - 4 sep 1987)			
	14:35152	*See* ISN–87-75			
CONF-8708231–		(High speed photography, videography, and photonics V; San Diego, California, USA; 17-19 Aug 1987)			
	14:34151	SPIE Society of Photo-Optical Instrumentation Engineers, 1022 19 St., P.O. Box 10, Bellingham, WA 98227			
CONF-8708269–		(10. European regional astronomy meeting of the IAU; Prague, Czechoslovakia; 24-29 Aug 1987)			
	14:34796	*See* INIS-mf–11450			
CONF-870905–		(6. Pacific Basin nuclear conference; Beijing, China; 7-11 Sep 1987)			
	14:33227				
	14:33324				
	14:33564				

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
	14:33597				
CONF-870909–		(Conference on nuclear interactions and structures; Brighton, UK; 7-9 Sep 1987)			
	14:35112	*See* CEA-CONF–9323			
CONF-8709132–		(6. international conference on secondary ion mass spectrometry - SIMS VI; Versailles, France; 13-18 Sep 1987)			
	14:34329	*See* IPNO-DRE–87-33(3)			
	14:34330	*See* IPNO-DRE–87-33(4)			
CONF-8709200–		(1. topical meeting on giant resonance excitation in heavy-ion collisions; Legnaro, Italy; 21-25 Sep 1987)			
	14:35059	*See* IPNO-DRE–87-39			
	14:35181	*See* ISN–87-95			
CONF-8709414–		(6. mass spectrometry colloquium; Strasbourg, France; 15-17 Sep 1987)			
	14:35225	*See* IPNO-DRE–87-33(5)			
	14:35226	*See* IPNO-DRE–87-33(6)			
CONF-8709419–		(FEMS symposium; Paris, France; 7-9 Sep 1987)			
	14:33383	*See* AFME–86.11.0245			
CONF-870971–		(Geostatistical sensitivity and uncertainty methods for groundwater flow and radionuclide transport modeling conference; San Francisco, California, USA; 15-17 Sep 1987)			
5	14:33264	*See* EGG-M–13387			
CONF-8710113–		(DOE direct liquefaction contractors' review meeting; Pittsburgh, Pennsylvania, USA; 6-8 Oct 1987)			
2	14:33167	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013145/JAW	MF-108
CONF-8710159–		(12. international conference on atomic collisions in solids; Okayama, Japan; 12-16 Oct 1987)			
	14:34910	*See* LYCEN–87-47			
	14:35232	*See* LYCEN–87-48			
CONF-8710218–		(International workshop on superconductive particle detectors; Torino, Italy; 26-29 Oct 1987)			
	14:34346	*See* LAPP-EXP–87-08			
CONF-8710356–		(GRS experts' discussion on operations experiences and reactor safety; Muenchen, Germany, F.R.; 29-30 Oct 1987)			
	14:33570	*See* GRS–68			
CONF-8710373–		(Riken-IN2P3 symposium on heavy-ion collisions; Shimoda, Japan; 11-15 Oct 1987)			
	14:34332	*See* ISN–87-83			
	14:35041	*See* IPNO-DRE–88-03			
CONF-8710416–		(13. MPA seminar on safety and reliability of pressure components: the contribution of component and large specimen testing to structural integrity assessment methodology; Stuttgart, Germany, F.R.; 8-9 Oct 1987)			
	14:33458	*See* INIS-mf–11982			
CONF-8710472–		(IAE AFBC technical meeting; Tokyo, Japan; Oct 1987)			
	14:34223	*See* STEV-FBT–89-16			
CONF-8710474–		(EORTC-Heavy Particles Therapy Group meeting; Muenchen, Germany, F.R.; 16-17 Oct 1987)			
	14:34630				
CONF-8711252–		(1. EPRI workshop on coal structure; Monterey, California, USA; 4-5 Nov 1987)			
1	14:33041	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013144/JAW	MF-108
CONF-8711302–		(Seminar on pressurized fluidized bed combustion and gasification power systems; Espoo, Finland; 23-24 Nov 1987)			
	14:33146	*See* VTT-SYMP–83			
CONF-8711306–		(Technical committee meeting on in situ leaching of uranium: Technical, environmental and economic aspects; Vienna, Austria; 3-6 Nov 1987)			
	14:33218	*See* IAEA-TECDOC–492			
CONF-871234–		(ASME winter meeting; Boston, Massachusetts, USA; 13-18 Dec 1987)			
	14:34173	American Society of Mechanical Engineers, 345 East 47 St., New York, NY 10017			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-880173–		(22. Moriond workshop on neutrinos and exotic phenomena in particle physics and astrophysics; Les Arcs, France; 23-30 Jan 1988)			
	14:34860	*See* LAPP-EXP–88-01			
CONF-880195–		(26. international winter meeting on nuclear physics; Bormio, Italy; 25-29 Jan 1988)			
	14:35072	*See* IPNO-DRE–88-06			
	14:35073	*See* IPNO-DRE–88-07			
CONF-880205–		(7. international conference and exhibit on offshore mechanics and arctic engineering (OMAE-7); Houston, Texas, USA; 7-12 Feb 1988)			
	14:33163	American Society of Mechanical Engineers, 345 East 47 St., New York, NY 10017			
CONF-880280–		(International conference on physics and astrophysics of quark-gluon plasma; Bombay, India; 8-12 Feb 1988)			
	14:34948	*See* CRN-PN–88-22			
CONF-8803113–		(8. Moriond astrophysics meeting on dark matter; Les Arcs, France; 6-13 Mar 1988)			
	14:34861	*See* LAPP-EXP–88-04			
	14:34863	*See* LAPP-TH–215-88			
CONF-8803216–		(1. KEK symposium on ultra cold neutrons (UCN); Tsukuba, Japan; 10 Mar 1988)			
	14:35182	*See* KEK–88-3			
CONF-8803217–		(Advisory group meeting on spent fuel management: Current status and prospects; Vienna, Austria; 15-18 Mar 1988)			
	14:33232	*See* IAEA-TECDOC–487			
CONF-8804279–		(Cryogenics '88; Usti nad Labem, Czechoslovakia; 19-21 Apr 1988)			
	14:34122	*See* INIS-mf–11454			
CONF-880497–		(Workshop on excavation effects on the engineering design and safety performance of an underground repository for radioactive waste; Winnipeg, Canada; 26-28 Apr 1988)			
	14:33252	*See* CEA-DAS–543			
CONF-8805294–		(Workshop on energy efficiency and structural change: implications for the greenhouse problem; Oakland, California, USA; 1-3 May 1988)			
Summs.	14:33710	*See* LBL–25716			
CONF-880604–		(Joint meeting of the 195th national meeting of the American Chemical Society and the 3rd Chemical Congress of North America; Toronto, Canada; 5-10 Jun 1988)			
17	14:33166	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013143/JAW	MF-108
CONF-880613–		(14. international symposium on effects of radiation on materials; Andover, Massachusetts, USA; 27-29 Jun 1988)			
32	14:33808	*See* BNL–42692			
CONF-8806217–		(ASME pressure vessel and piping conference: vibration and seismic response of fluid-structure systems; Pittsburgh, Pennsylvania, USA; 19-23 Jun 1988)			
	14:33478	*See* CEA-CONF–9699			
	14:33513	*See* CEA-CONF–9700			
	14:34169	*See* CEA-CONF–9708			
CONF-8806236–		(1. European workshop on hadronic physics in the 1990's with multi-GeV electrons; Seillac, France; 27 Jun - 1 jul 1988)			
	14:35043	*See* CEA-CONF–9663			
CONF-8806243–		(DPF summer study: Snowmass '88: high energy physics in the 1990s; Snowmass, Colorado, USA; 27 Jun - 15 jul 1988)			
40	14:34962	*See* FNAL/C–89/26			
42	14:34234	*See* SLAC-PUB–4868			
Exc.	14:34233	*See* SLAC–334			
CONF-8806285–		(31. colloquium of metallurgy at Saclay on gas in materials; Saclay, France; 20-22 Jun 1988)			
	14:34050	*See* CEA-CONF–9777			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-880531–		(29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, Nevada, USA; 26-29 Jun 1988)			
	14:33337				
CONF-8806366–		(1. contractors' meeting on the results of the subprogramme 'production and utilization of new energy vectors'; Saarbruecken, Germany, F.R.; 6-8 Jun 1988)			
	14:33079	*See* EUR–11843			
CONF-8806367–		(Technical review on advances in geothermal reservoir technology: research in progress; Berkeley, California, USA; 14-15 Jun 1988)			
	14:33425	*See* LBL–25635			
CONF-8806372–		(Regional seminar on improvement of crops in Africa through the use of induced mutations; Lusaka, Zambia; 20-24 Jun 1988)			
	14:34632	*See* IAEA-TECDOC–496			
CONF-8806374–		(Workshop on ceramic materials for fusion; Tokyo, Japan; Jun 1988)			
	14:35442	*See* CEA-CONF–9763			
CONF-880695–		(1. European Particle Accelerator Conference (EPAC-1); Rome, Italy; 7-11 Jun 1988)			
	14:35202	*See* GANIL-A–88-02			
CONF-8807155–		(4. international symposium on small particles and inorganic clusters (ISSPIC-4); Aix-en-Province, France; 5-9 Jul 1988)			
	14:34918				
CONF-880736–		(12. international cryogenic engineering conference and exhibition; Southampton, UK; 12-15 Jul 1988)			
6	14:34117	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013482/JAW	MF-406
CONF-880766–		(5. international conference on clustering aspects in nuclear and subnuclear systems; Kyoto, Japan; 25-29 Jul 1988)			
	14:35091	*See* GANIL-P–88-11			
CONF-880787–		(3. international symposium on the synthesis and applications of isotopically labeled compounds; Innsbruck, Austria; 17-21 Jul 1988)			
4	14:34075	*See* LBL–25560			
5	14:34076	*See* LBL–25587			
CONF-8808151–		(Offshore northern seas conference and exhibition; Stavanger, Norway; 23-26 Aug 1988)			
	14:33161	*See* NEI-NO–86			
	14:33174	*See* NEI-NO–88			
	14:33185	*See* NEI-NO–84			
	14:33189	*See* NEI-NO–87			
CONF-8808223–		(AAPG Rocky Mountain Section meeting; Bismarck, North Dakota, USA; 21-24 Aug 1988)			
	14:33157				
CONF-8808233–		(Conference on X-ray microscopy in biology and medicine; Tochigi, Japan; 25-27 Aug 1988)			
1	14:34365	*See* LBL–27040			
CONF-880897–		(Conference and exposition on future transportation technology; San Francisco, California, USA; 8-11 Aug 1988)			
	14:33125	Society of Automotive Engineers, 400 Commonwealth Dr., Warrendale, PA 15096			
CONF-8809125–		(NATO ASI on plasma surface interaction and processing of materials; Alicante, Spain; 4-16 Sep 1988)			
2	14:35231	*See* LA-UR–89-1486			
CONF-8809356–		(2. IFIP WG 7.5 working conference on reliability and optimization of structural systems; London, UK; 26-28 Sep 1988)			
	14:34224	*See* AUC-IBT-R–8828			
CONF-8809361–		(Surface and interface of ceramics materials summer school; Oleron, France; 4-16 Sep 1988)			
	14:33944	*See* CEA-CONF–9766			

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CONF-8810117–		(Workshop on applications of synchrotron radiation in chemical research; Argonne, Illinois, USA; 3-4 Oct 1988)			
2	14:33948	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014677/JAW	MF-401
CONF-8810118–		(Workshop on momentum distributions; Argonne, Illinois, USA; 24-26 Oct 1988)			
9	14:34930	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014679/JAW	MF-411
CONF-8810126–		(Workshop on scientific opportunities for infrared free electron lasers; Berkeley, California, USA; 31 Oct - 1 nov 1988)			
Vol.1-Summ.	14:34148	*See* LBL–26783-Vol.1			
CONF-8810133–		(1. international symposium on field screening methods for hazardous waste site investigations; Las Vegas, Nevada, USA; 11-13 Oct 1988)			
6	14:34052	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013013/JAW	MF-407
CONF-8810135–		(Switched-power workshop; Shelter Island, New York, USA; 16-21 Oct 1988)			
5	14:34276	*See* BNL–42812			
CONF-881014–		(International European Nuclear Society/American Nuclear Society meeting on thermal reactor safety; Avignon, France; 2-7 Oct 1988)			
	14:33568	*See* CEA-DAS–533e			
CONF-8810155–		(16. water reactor safety information meeting; Gaithersburg, Maryland, USA; 24-27 Oct 1988)			
Vol.1	14:33591	*See* NUREG/CP–0097-Vol.1			
CONF-8810170–		(DOE direct liquefaction contractor's conference; Pittsburgh, Pennsylvania, USA; 4-6 Oct 1988)			
4	14:33062	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013142/JAW	MF-108
CONF-8810264–		(Conference on hadronic matter in collision; Tucson, Arizona, USA; 6-12 Oct 1988)			
13	14:35089	*See* BNL–42804			
CONF-8810305–		(15. Meeting of the Association pour les Techniques et les Sciences de Radioprotection on Dismantling of Nuclear Plants, Wastes and Associated Problems of Radiation Protection; Grenoble, France; 5-7 Oct 1988)			
	14:33251	*See* CEA-CONF–9704			
CONF-8810330–		(International conference on environment-induced crack growth of metals; Kohler, Wisconsin, USA; 5 Oct 1988)			
2-Rev.1	14:33906	*See* UCRL–97917-Rev.1			
CONF-8810341–		(Global catastrophes conference; Snowbird, Utah, USA; 20-23 Oct 1988)			
2	14:34429	*See* UCRL–98894-Rev.1			
CONF-8810356–		(3. joint US-Cern accelerator school on particle accelerators: frontiers of particle beams, observations, diagnosis, and correction; Capri, Italy; 20-26 Oct 1988)			
2	14:34309	*See* SLAC-PUB–4974			
CONF-8810376–		(NATO advanced study institute on atoms in strong fields; Kos, Greece; 9-21 Oct 1988)			
1	14:34913	*See* UCRL–101134			
CONF-8810380–		(Conference on materials analysis by physical techniques; Risley, UK; 4-5 Oct 1988)			
	14:33807	*See* AERE-R–13380			
CONF-8811161–		(MRS symposium on high-temperature ordered intermetallic alloys; Boston, Massachusetts, USA; 28 Nov - 3 dec 1988)			
5	14:33847	*See* DOE/ER/45213–6			
CONF-8811217–		(Maroco-French cooperation in nuclear safety; Rabat, Massachusetts, USA; 28 Nov - 3 dec 1988)			
	14:33546	*See* CEA-DAS–568			
CONF-881151–		(International conference on the application of accelerators in research and industry; Denton, Texas, USA; 7-9 Nov 1988)			
63	14:34907	*See* LBL–25423			
CONF-881249–		(National Governor's Association meeting: finding the future conference; Washington, D.C., USA; 12-14 Dec 1988)			
4	14:34706	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013011/JAW	MF-407

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CONF-881290–		(Seminar on nuclear data; Tokai, Japan; 8-9 Dec 1988)			
	14:33531	*See* JAERI-M–89-026			
CONF-890103–		(6. symposium on space nuclear power systems; Albuquerque, New Mexico, USA; 9-12 Jan 1989)			
10	14:33565	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013192/JAW	MF-528
CONF-8901120–		(27. international winter meeting on nuclear physics; Bormio, Italy; 23-27 Jan 1989)			
3	14:35090	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013058/JAW	MF-414
CONF-890114–		(14. workshop on geothermal reservoir engineering; Stanford, California, USA; 24-26 Jan 1989)			
5	14:33426	*See* LBL–26819			
CONF-890207–		(Waste management '89; Tucson, Arizona, USA; 26 Feb - 2 mar 1989)			
33	14:33254	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013090/JAW	MF-802
CONF-8902100–		(TMS symposium on high temperature superconductors; Las Vegas, Nevada, USA; 27 Feb - 3 mar 1989)			
2	14:33890	*See* LBL–27064			
CONF-8902109–		(International workshop on appropriate methodologies for development and management of groundwater resources in developing countries; Hyderabad, India; 28 Feb - 4 mar 1989)			
1	14:34462	*See* LBL–27031			
CONF-8902112–		(29. annual convention of the Radioisotope Society of the Philippines; Quezon City, Philippines; 28 Feb 1989)			
	14:33482	*See* INIS-mf–11425			
CONF-890216–		(International symposium on high T_c superconducting oxides: processing and related properties; Las Vegas, Nevada, USA; 27-28 Feb 1989)			
2	14:33945	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013626/JAW	MF-404
CONF-890231–		(5. international wire chamber conference; Vienna, Austria; 13-17 Feb 1989)			
	14:34352	*See* RAL–89-018			
CONF-890270–		(International industrial symposium on the super collider; New Orleans, Louisiana, USA; 8-10 Feb 1989)			
19	14:34304	*See* LBL–26246			
CONF-8903109–		(5. international aluminum-lithium conference; Williamsburg, Virginia, USA; 28-31 Mar 1989)			
4	14:33889	*See* LBL–26651			
5	14:33888	*See* LBL–26168			
CONF-8903111–		(Lunar planetary science conference; Houston, Texas, USA; 12-18 Mar 1989)			
2	14:34757	*See* LA-UR–89-1791			
CONF-8903131–		(Chapman conference on the physics of magnetic flux ropes; Hamilton, Bermuda; 27-31 Mar 1989)			
2	14:34864	*See* LA-UR–89-1593			
CONF-890335–		(13. particle accelerator conference; Chicago, Illinois, USA; 20-23 Mar 1989)			
188	14:35461	*See* LBL–25998			
189	14:34248	*See* LBL–25983			
190	14:35458	*See* LBL–25985			
191	14:34231	*See* LBL–27174			
192	14:34247	*See* LBL–25958			
193	14:34246	*See* LBL–25955			
194	14:35460	*See* LBL–25995			
195	14:35459	*See* LBL–25989			
196	14:34282	*See* FNAL-TM–1586			
197	14:34275	*See* BNL–42448			
198	14:34238	*See* BNL–41897			
199	14:34274	*See* BNL–41899			
200	14:34239	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014675/JAW	MF-414
201	14:34252	*See* SLAC-PUB–4919			
202	14:34251	*See* SLAC-PUB–4907			
206	14:34235	*See* SLAC-PUB–4936			
208	14:34253	*See* SLAC-PUB–4953			
210	14:34237	*See* ANL-HEP-PR–89-45			
211	14:34278	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014638/JAW	MF-413

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CONF-890379--		(Workshop on calorimetry for the SSC; Tuscaloosa, Alabama, USA; 13-17 Mar 1989)			
6	14:34319	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013005/JAW	MF-414
7	14:34318	*See* ANL-HEP-CP--89-48			
8	14:34946	*See* ANL-HEP-CP--89-40			
9	14:34353	*See* SLAC-PUB--4939			
CONF-890387--		(Workshop on highly charged ions: new physics and advanced techniques; Berkeley, California, USA; 13-15 Mar 1989)			
6	14:34909	*See* LBL--26900			
CONF-890402--		(10. international conference on fluidized-bed combustion; San Francisco, California, USA; 30 Apr - 3 may 1989)			
7	14:33137	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014669/JAW	MF-103
CONF-890406--		(Fifty years with nuclear fission conference; Gaithersburg, Maryland, USA; 25-28 Apr 1989)			
21	14:35039	*See* LBL--27144			
22	14:35094	*See* LBL--27177			
CONF-890410--		(Nuclear analytical methods in the life sciences; Gaithersburg, Maryland, USA; 17-21 Apr 1989)			
2	14:34048	*See* BNL--42711			
CONF-8904107--		(2. international conference on high-density pinches (ICHDP-2); Laguna Beach, California, USA; 26-28 Apr 1989)			
3	14:35510	*See* SAND--89-0289C			
CONF-890415--		(Computing in high energy physics; Oxford, UK; 10-14 Apr 1989)			
3	14:34942	*See* ANL-HEP-CP--89-50			
4	14:34285	*See* FNAL-TM--1596			
CONF-8904194--		(INGRES User Association meeting; New Orleans, Louisiana, USA; 23-27 Apr 1989)			
3	14:33294	*See* SAND--89-0838C			
CONF-890421--		(91. annual meeting of the American Ceramic Society; Indianapolis, Indiana, USA; 23-27 Apr 1989)			
9	14:33612	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013547/JAW	MF-404
10	14:33255	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014671/JAW	MF-814
CONF-8904210--		(Cray user's group conference; Los Angeles, California, USA; 24-28 Apr 1989)			
4	14:35500	*See* UCRL--101076			
CONF-8904215--		(Symposium on fabrication and properties of lithium ceramics; Indianapolis, Indiana, USA; 24-26 Apr 1989)			
3	14:35443	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014667/JAW	MF-423
CONF-8904216--		(Gamma ray observatory science workshop; Greenbelt, Maryland, USA; 10-12 Apr 1989)			
4	14:34871	*See* UCRL--101129			
CONF-890423--		(CLEO '89: conference on lasers and electro optics; Baltimore, Maryland, USA; 24-28 Apr 1989)			
10	14:35470	*See* UCRL--100012			
CONF-890426--		(Spring meeting of the Materials Research Society; San Diego, California, USA; 24-28 Apr 1989)			
16	14:33976	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013062/JAW	MF-404
17	14:33990	*See* UCRL--99832			
18	14:34305	*See* LBL--27162			
19	14:34347	*See* LBL--26997			
20	14:33809	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014640/JAW	MF-404
CONF-890468--		(16. international conference on metallurgical coatings and equipment exhibit; San Diego, California, USA; 17-21 Apr 1989)			
9	14:33810	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014665/JAW	MF-373
10	14:33811	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014666/JAW	MF-114
CONF-890478--		(12. world conference on non-destructive testing; Amsterdam, Netherlands; 23-28 Apr 1989)			
	14:34205	*See* RISO-M--2770			
CONF-8905118--		(2. international conference on trends in welding research; Gatlinburg, Tennessee, USA; 15-19 May 1989)			
10	14:33816	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013537/JAW	MF-404
11	14:33817	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013548/JAW	MF-000
12	14:33818	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013545/JAW	MF-000

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CONF-8905120–		(8. topical conference on radio frequency power in plasmas; Irvine, California, USA; 1-3 May 1989)			
13	14:35431	*See* UCRL–100574			
14	14:35433	*See* UCRL–100591			
15	14:35432	*See* UCRL–100575			
16	14:35404	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013049/JAW	MF-420
17	14:35405	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013059/JAW	MF-420
CONF-8905122–		(13. actinide separations conference; Idaho Falls, Idaho, USA; May 1989)			
4	14:34063	*See* RFP–4317			
6-Vugraphs	14:33316	*See* WSRC-RP–89-145			
CONF-8905134–		(JANNAF propulsion meeting; Cleveland, Ohio, USA; 22-25 May 1989)			
2	14:34935	*See* UCRL–101020			
CONF-8905135–		(Joint NEA/CEC workshop on sealing of radioactive waste repositories; Braunschweig, Germany, F.R.; 22-25 May 1989)			
2	14:33306	*See* SAND–89-1285C			
CONF-8905159–		(Joint IAEA technical committee meeting on ECE and ECRH and 7th joint workshop on ECE and ECRH (EC-7); Hefei, China; 8-11 May 1989)			
1	14:35410	*See* GA-A–19667			
CONF-890517–		(10. symposium on microdosimetry; Rome, Italy; 21-26 May 1989)			
2	14:34670	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013063/JAW	MF-408
CONF-890518–		(175. meeting of the Electrochemical Society; Los Angeles, California, USA; 7-12 May 1989)			
3	14:33987	*See* SAND–89-1282C			
CONF-890526–		(44. annual Purdue industrial waste conference; West Lafayette, Indiana, USA; 9-11 May 1989)			
1	14:34461	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014757/JAW	MF-000
CONF-890545–		(6. conference on real-time computer applications in nuclear, particle and plasma physics; Williamsburg, Virginia, USA; 15-18 May 1989)			
2	14:34137	*See* UCRL–100548			
3	14:35486	*See* FNAL/C–89/118			
CONF-890555–		(7. power plant dynamics, control and testing symposium; Knoxville, Tennessee, USA; 15-17 May 1989)			
17	14:33450	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013538/JAW	MF-222
CONF-890565–		(11. annual ESARDA symposium on safeguards and nuclear materials management; , Luxembourg; 30 May - 1 jun 1989)			
4	14:33331	*See* LA-UR–89-1715			
5	14:33332	*See* LA-UR–89-1776			
6	14:33517	*See* LA-UR–89-1772			
CONF-890585–		(11. international symposium on ballistics; Brussels, Belgium; 9-11 May 1989)			
5	14:34378	*See* UCRL–100429			
CONF-890586–		(Workshop on advanced laser technology for chemical measurement; Argonne, Illinois, USA; 9-11 May 1989)			
1	14:34895	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014634/JAW	MF-407
CONF-890609–		(ASHRAE annual meeting; Vancouver, Canada; 24-28 Jun 1989)			
4	14:33716	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013543/JAW	MF-350
CONF-890610–		(ASES annual meeting and 14th annual passive solar conference; Denver, Colorado, USA; 19-23 Jun 1989)			
4	14:33743	*See* SERI/TP–254-3492			
CONF-8906124–		(Meeting of the Association of Energy Systems Operations and Programming; Morgantown, West Virginia, USA; 6-9 Jun 1989)			
1	14:35501	*See* WSRC-RP–89-123			
CONF-8906125–		(Workshop on multiparticle dynamics; Perugia, Italy; 21-28 Jun 1989)			
	14:34970	*See* INFN-LNF–89-008(PT)			
CONF-890619–		(34. annual meeting of the Health Physics Society; Albuquerque, New Mexico, USA; 25-29 Jun 1989)			
2	14:33256	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013705/JAW	MF-407

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CONF-890620–		(2. international reservoir characterization technical conference; Dallas, Texas, USA; 25-28 Jun 1989)			
1	14:33156	*See* SAND–89-1435C			
CONF-890627–		(19. biennial conference on carbon; University Park, Pennsylvania, USA; 25-30 Jun 1989)			
1	14:33977	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013703/JAW	MF-404
CONF-890631–		(International symposium on packaging and transporting of radioactive materials; Washington, D.C., USA; 11-16 Jun 1989)			
22	14:33296	*See* SAND–89-0959C			
31	14:34133	*See* SAND–89-0987C			
32	14:33304	*See* SAND–89-1007C			
33	14:33295	*See* SAND–89-0940C			
34	14:33299	*See* SAND–89-0980C			
35	14:33307	*See* SAND–89-7071C			
36	14:33305	*See* SAND–89-1137C			
37	14:33303	*See* SAND–89-0992C			
38	14:33298	*See* SAND–89-0979C			
39	14:33277	*See* K/QT–301			
40	14:34131	*See* SAND–89-0941C			
41	14:33297	*See* SAND–89-0960C			
42	14:33315	*See* WHC-SA–0570			
43	14:33314	*See* WHC-SA–0426			
44	14:34132	*See* SAND–89-0983C			
45	14:33230	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013544/JAW	MF-820
46	14:33300	*See* SAND–89-0981C			
47	14:33302	*See* SAND–89-0988C			
48	14:33301	*See* SAND–89-0982C			
49	14:33231	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013535/JAW	MF-000
50	14:34123	*See* K/SS–528			
51	14:34136	*See* UCRL–99652			
52	14:33289	*See* POEF-A–355			
CONF-890653–		(First European Ceramic Society conference (ECerS-1); Maastricht, Netherlands; 19-23 Jun 1989)			
1	14:33946	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013012/JAW	MF-332
CONF-890660–		(Institute of Electrical and Electronics Engineers (IEEE) Antennas Propagation Society (AP-S) international symposium; San Jose, California, USA; 26-30 Jun 1989)			
8	14:35297	*See* SAND–89-7082C			
CONF-890661–		(3. international symposium on behavior of media under high dynamic pressures; La Grande Motte, France; 5-9 Jun 1989)			
6-Rev.	14:34372	*See* UCRL–98864-Rev.			
CONF-890663–		(International superconductivity electronics conference (ISEC '89); Tokyo, Japan; 12-13 Jun 1989)			
1	14:33963	*See* SAND–89-1300C			
CONF-890665–		(7. Institute of Electrical and Electronics Engineers pulsed power conference; Monterey, California, USA; 12-14 Jun 1989)			
3	14:34250	*See* SAND–89-0081C			
7	14:34212	*See* SAND—88-3475C			
8	14:35464	*See* SAND–88-3238C			
11	14:34214	*See* SAND–89-0048C			
12	14:34227	*See* SAND–89-0071C			
13	14:34307	*See* SAND–88-3427C			
14	14:35469	*See* SAND–89-1494C			
15	14:34310	*See* UCRL–100122			
16	14:34232	*See* SAND–89-0080C			
17	14:35468	*See* SAND–89-1458C			
21	14:35465	*See* SAND–89-0091C			
24	14:34306	*See* SAND–88-3335C			
CONF-890666–		(Gasification and gas stream cleanup systems; Morgantown, West Virginia, USA; 27-30 Jun 1989)			
1	14:33040	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013010/JAW	MF-109
CONF-890674–		(7. international conference on Fourier transform spectroscopy; Fairfax, Virginia, USA; 19-23 Jun 1989)			
2	14:34065	*See* SAND–88-3367C			

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CONF-890692–		(82. Air and Waste Management Association annual meeting and exhibition; Anaheim, California, USA; 25-30 Jun 1989)			
4-Rev.1	14:34430	*See* UCRL–99926-Rev.1			
CONF-890702–		(28. international geological congress; Washington, DC, US; July 9, 1989)			
1	14:34727	NTIS, PC A02/MF A01 - OSTI	E 1.99:	DE89001521/JAW	MF-401
CONF-890703–		(International conference on ion sources; Berkeley, California, USA; 9-15 Jul 1989)			
1	14:34906	*See* LA-UR–89-1876			
3	14:35466	*See* SAND–89-0274C			
5	14:34308	*See* SAND–89-0299C			
6	14:35467	*See* SAND–89-0276C			
7	14:34896	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014774/JAW	MF-420
CONF-890705–		(8. international zeolite conference; Amsterdam, Netherlands; 10-14 Jul 1989)			
2	14:33986	*See* SAND–89-0664C			
CONF-890720–		(15. international congress on glass; Leningrad, SU; July 2, 1989)			
1	14:33947	NTIS, PC A02/MF A01 - OSTI	E 1.99:	DE89002214/JAW	MF-404
CONF-890721–		(Joint ASME/JSME pressure vessel and piping conference; Honolulu, Hawaii, USA; 23-27 Jul 1989)			
2	14:33493	*See* SAND–88-1761C			
3	14:33524	*See* SAND–88-2203C			
4	14:33459	*See* SAND–88-2145C			
5	14:34118	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89004933/JAW	MF-406
6	14:33539	*See* SAND–88-2209C			
7	14:33544	*See* SAND–88-7170C			
8	14:34125	*See* LA-UR–89-5			
9	14:33812	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89007823/JAW	MF-404
33	14:33566	*See* BNL-NUREG–42704			
34	14:33567	*See* BNL-NUREG–42722			
CONF-890723–		(26. annual conference on nuclear and space radiation effects; Marco Island, Florida, USA; 24-28 Jul 1989)			
1	14:34216	*See* SAND–89-0218C			
2	14:34215	*See* SAND–89-0181C			
3	14:34360	*See* SAND–89-0379C			
4	14:34210	*See* LA-UR–89-490			
7	14:35494	*See* SAND–89-0459C			
CONF-890736–		(30. annual meeting of the Institute of Nuclear Materials Management; Orlando, Florida, USA; 9-12 Jul 1989)			
1	14:33333	*See* LA-UR–89-1862			
3	14:33290	*See* RFP–4302			
4	14:35472	*See* SAND–89-1112C			
5	14:33334	*See* SAND–89-1114C			
9	14:33335	*See* SAND–89-1602C			
CONF-890739–		(12. international colloquium on the dynamics of explosions and reactive systems; Ann Arbor, Michigan, USA; 23-28 Jul 1989)			
1	14:34371	*See* SAND–89-0090C			
CONF-890742–		(2. Shrivenham international conference on algorithms for approximation; Shrivenham, UK; 12-15 Jul 1989)			
1	14:35499	*See* UCRL–98149			
CONF-890748–		(Microbeam Analysis Society meeting; Asheville, North Carolina, USA; 16-21 Jul 1989)			
1	14:34761	*See* LA-UR–89-645			
2	14:34762	*See* LA-UR–89-646			
3	14:33813	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89007835/JAW	MF-404
4	14:34366	*See* SAND–89-0589C			
5	14:34207	*See* SAND–89-0633C			
6	14:34206	*See* SAND–89-0490C			
7	14:33903	*See* SAND–89-0683C			
8	14:34312	*See* BNL–42582			
CONF-890752–		(6. international conference on numerical methods in laminar and turbulent flows; Swansea, UK; 11-15 Jul 1989)			
3	14:34934	*See* UCRL–100203			

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CONF-890768–		(International geoscience and remote sensing symposium; Vancouver, Canada; 10-14 Jul 1989)			
2	14:34716	*See* DOE/ER/13796–2			
3	14:34458	*See* LA-UR–89-1305			
CONF-890769–		(3. international symposium on analysis and detection of explosives; Mannheim, Germany, F.R.; 10-13 Jul 1989)			
1	14:34370	*See* SAND–88-3239C			
CONF-890773–		(National Conference of Standards Laboratories (NCSL) annual conference and symposium; Denver, Colorado, USA; 9-13 Jul 1989)			
1	14:33687	*See* SAND–88-3408C			
CONF-890781–		(IEEE summer power meeting; Long Beach, California, USA; 9-14 Jul 1989)			
1	14:33451	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012348/JAW	MF-222
2	14:33452	NTIS, PC A02/MF A01 - OSTI		DE89012338/JAW	MF-222
CONF-890782–		(2. symposium on expert systems application to power systems; Seattle, Washington, USA; 17-20 Jul 1989)			
1	14:33569	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012507/JAW	MF-605
CONF-890783–		(16. AUVS annual technical symposium and exhibit; Washington, D.C., USA; 17-19 Jul 1989)			
1	14:34129	*See* SAND–89-0393C			
CONF-890784–		(Quantitative three-dimensional structural techniques; Washington, D.C., USA; 15-16 Jul 1989)			
	14:34717	*See* DOE/ER/13796–6			
CRA–					
208.02	14:33192	*See* PB–89-148894/XAB			
CRAD–					
1/88	14:34115	*See* AD-A–201400/9/XAB			
CRC–					
561	14:34714	*See* AD-A–201482/7/XAB			
CRIEPI-T–					
87076	14:33126	Central Research Inst. of Electric Power Industry, Tokyo (Japan)			ND-000
CRIEPI-W–					
87030	14:33138	Central Research Inst. of Electric Power Industry, Tokyo (Japan)			ND-000
87038	14:33033	Central Research Inst. of Electric Power Industry, Tokyo (Japan)			ND-000
87044	14:33063	Central Research Inst. of Electric Power Industry, Tokyo (Japan)			ND-000
87045	14:33064	Central Research Inst. of Electric Power Industry, Tokyo (Japan)			ND-000
CRN-CPR–					
88-05	14:35406	NTIS (US Sales Only), PC A03/MF A01		DE89781552/JAW	MF-000
CRN-HE–					
8608	14:34947	NTIS (US Sales Only), PC A03/MF A01		DE89781502/JAW	MF-000
CRN-PN–					
8614	14:35066	NTIS (US Sales Only), PC A03/MF A01		DE89781503/JAW	MF-000
88-16	14:34279	NTIS (US Sales Only), PC A03/MF A01		DE89781554/JAW	MF-000
88-22	14:34948	NTIS (US Sales Only), PC A02/MF A01		DE89781488/JAW	MF-000
88-31	14:35113	NTIS (US Sales Only), PC A03/MF A01		DE89781550/JAW	MF-000
89-05	14:34320	NTIS (US Sales Only), PC A03/MF A01		DE89781592/JAW	MF-000
CRN-VIV–					
56	14:34280	NTIS (US Sales Only), PC A03/MF A01		DE89781526/JAW	MF-000
CTA-IEAv-RI–					
001/83	14:33529	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89620448/JAW	MF-000
CTH-OOK–					
88-13	14:34066	*See* STEV-FBT–89-21			
CTH-RF–					
60	14:35174	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89617842/JAW	MF-000
DCN–					
88-239-004-41-07	14:34424	*See* PB–89-155055/XAB			
DDA-EDR–					
13632	14:33779	*See* AD-A–201292/0/XAB			
DFVLR-FB–					
89-02	14:34099	NTIS (US Sales Only), PC A06/MF A01;1		DE89783263/JAW	MF-000
DGMK–					
384-1	14:33132	Copy held by UB/TIB Hannover.			MF-000

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DIA-DST–					
2700Z-004-88	14:34142	*See* AD-A–201593/1/XAB			
DOE-RW–					
87.128	14:33259	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89617422/JAW	MF-000
89.009	14:33250	*See* AERE-R–13318			
89.022	14:33260	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89618317/JAW	MF-000
89.024	14:34504	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89617980/JAW	MF-000
DOE-tr–					
118	14:33756	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89010480/JAW	MF-706
DOE/BC/14126–					
7	14:33154	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89000752/JAW	PC-122
8	14:33160	NTIS, PC A09/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89000753/JAW	PC-122
DOE/BP–					
1212	14:33717	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013097/JAW	MF-900
1213	14:33638	NTIS, PC A19/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013078/JAW	MF-900
DOE/BP/12921–					
4-Vol.1	14:33718	NTIS, PC A07/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013031/JAW	MF-402; MN-350
5-Vol.2-App.	14:33719	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013032/JAW	MF-402; MN-350
DOE/BP/16726–					
4	14:33377	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013098/JAW	MF-902
DOE/BP/17622–					
2	14:33378	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013096/JAW	MF-902
DOE/BP/36834–					
1	14:33379	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013095/JAW	MF-908
DOE/BP/39166–					
1	14:33753	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013080/JAW	MF-220
DOE/BP/60288–					
3	14:33720	NTIS, PC A10/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013094/JAW	MF-350
DOE/BP/64355–					
1	14:33721	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013077/JAW	MF-350
DOE/DP/40130–					
2	14:34146	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013018/JAW	MF-712
DOE/DP/40131–					
02	14:35444	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013017/JAW	MF-712
04	14:35445	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013019/JAW	MF-712
DOE/DP/48058–					
1	14:33661	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013509/JAW	MF-700
DOE/EIA–					
0064(87)	14:33133	NTIS, PC A06/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE89013218/JAW	MF-950
0121(88/4Q)	14:33151	NTIS, PC A07/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE89011793/JAW	MF-98A
0130(89/03)	14:33188	NTIS, PC A07/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE89013213/JAW	MF-950
0226(89/03)	14:33664	NTIS, PC A08/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014645/JAW	MF-950
0293(89)	14:33639	NTIS, PC A05/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE89012600/JAW	MF-950
0314(87)	14:33672	NTIS, PC A12/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE89014621/JAW	MF-950
0333(89)	14:33152	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013099/JAW	MF-950
0340(88/2)	14:33171	NTIS, PC A20/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE89013818/JAW	MF-950
0363(89)	14:33153	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014644/JAW	MF-950
0380(89/03)	14:33172	NTIS, PC A09/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE89013478/JAW	MF-950
0384(88)	14:33173	NTIS, PC A14/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE89012601/JAW	MF-950
0473(88)	14:33454	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014646/JAW	MF-950
0525	14:33198	NTIS, PC A05/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE89012937/JAW	MF-950
0526	14:33709	NTIS, PC A03/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE89013477/JAW	MF-950
DOE/ER–					
0411	14:34382	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012869/JAW	PC-402
DOE/ER/13243–					
5	14:34897	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013114/JAW	MF-411
DOE/ER/13369–					
4	14:33384	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013670/JAW	MF-408
DOE/ER/13394–					
4	14:34898	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013022/JAW	MF-410
DOE/ER/13396–					
T1	14:34119	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014653/JAW	MF-406
DOE/ER/13404–					
4	14:34095	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013111/JAW	MF-401
DOE/ER/13461–					
3	14:34517	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014714/JAW	MF-408

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
DOE/ER/13552–					
T1	14:34053	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013470/JAW	MF-401
DOE/ER/13774–					
T1	14:34070	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012946/JAW	MF-401
DOE/ER/13796–					
2	14:34716	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89010875/JAW	MF-403
6	14:34717	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89010879/JAW	MF-403
DOE/ER/13880–					
1	14:34071	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012945/JAW	MF-401
DOE/ER/25026–					
28	14:35483	Univ. of Illinois at Urbana-Champaign, 1304 W. Springfield Ave., Urbana, IL 61801-2987			ND-405
29	14:35484	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014812/JAW	MF-405
30	14:35485	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014813/JAW	MF-405
DOE/ER/30107–					
T1	14:34383	NTIS, PC A04/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE89012964/JAW	MF-402
DOE/ER/40125–					
17	14:34949	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013106/JAW	MF-414
18	14:34959	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013107/JAW	MF-414
19	14:34770	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013108/JAW	MF-414
20	14:34960	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013105/JAW	MF-414
21	14:34321	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013109/JAW	MF-414
DOE/ER/40150–					
69	14:34281	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012314/JAW	MF-414
DOE/ER/40319–					
3-Pt.1.	14:34943	NTIS, PC A07/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013020/JAW	MF-414
3-Pt.2	14:34961	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013021/JAW	MF-414
DOE/ER/45080–					
T3	14:33846	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014696/JAW	MF-404
DOE/ER/45213–					
6	14:33847	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013112/JAW	MF-404
DOE/ER/45265–					
T3	14:35201	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013510/JAW	MF-410
DOE/ER/52147–					
2	14:34147	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014715/JAW	MF-414
DOE/ER/53175–					
T1	14:35407	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013681/JAW	MF-420
DOE/ER/53227–					
134	14:35408	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012875/JAW	PC-426
DOE/ER/60502–					
03	14:34671	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013800/JAW	MF-408
DOE/ET/44802–					
T23	14:34728	OSTI - USGS Open File Service, Box 25425, Denver Federal Center, Denver, CO 80225 $4.00 (4.00)		TI89012409/JAW	MF-703
DOE/ET/51013–					
263	14:35409	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014650/JAW	MF-422
DOE/FTR–					
9012955	14:34228	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012955/JAW	MF-405
DOE/ID/10333–					
T1	14:33422	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012649/JAW	MF-258
DOE/ID/12118–					
2	14:33371	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012871/JAW	MF-225
DOE/IG–					
0267	14:35475	OSTI		TI89013327/JAW	PC-960
DOE/MC/20422–					
2691	14:33186	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89000985/JAW	PC-132; STD-132
2692	14:33187	NTIS, PC A07/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89000986/JAW	PC-132; STD-132
DOE/MC/22134–					
2698	14:33211	NTIS, PC A15/MF A01 - OSTI		DE89000976/JAW	MF-123
DOE/MC/22184–					
2661	14:34362	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89000910/JAW	PC-115; STD-115
DOE/MC/23258–					
2693	14:33780	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89000978/JAW	PC-111; STD-111

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
DOE/MC/23287– 2657	14:33341	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89000932/JAW	PC-106; STD-106
DOE/MC/24160– 2671	14:33127	NTIS, PC A07/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89000950/JAW	PC-106; STD-106
DOE/MC/24267– 2665	14:33065	NTIS, PC A08/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89000942/JAW	PC-109; STD-109
DOE/NE/44139– 40	14:33257	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012367/JAW	PC-510; STD-510
DOE/NV/10322– 36	14:34120	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013217/JAW	MF-703
DOE/NV/10571– T2	14:34899	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014699/JAW	MF-712
DOE/OR/20722– 208	14:33258	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014791/JAW	MF-511
DOE/OR/21400– T352	14:33754	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89010393/JAW	PC-310; STD-310
T357	14:33755	NTIS, PC A12/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89009038/JAW	PC-310; STD-310
DOE/OR/21548– 046-Rev.1	14:33328	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014623/JAW	MF-511
DOE/PC/63032– T19	14:33066	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89009052/JAW	PC-102; STD-102
DOE/PC/70780– T10	14:33357	NTIS, PC A18/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013802/JAW	MF-108
DOE/PC/79668– T3	14:34379	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012706/JAW	MF-112
DOE/PC/79670– 1	14:33681	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012646/JAW	MF-112
2	14:33682	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012647/JAW	MF-112
3	14:33683	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012644/JAW	MF-112
4	14:33684	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012645/JAW	MF-112
DOE/PC/79671– T1	14:33685	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89008564/JAW	MF-112
DOE/PC/79672– T2	14:33686	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012590/JAW	MF-112
DOE/PC/79808– T1	14:33067	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013513/JAW	MF-108
DOE/PC/79815– T1	14:33068	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014652/JAW	MF-108
DOE/PC/79925– 5	14:33120	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013224/JAW	MF-113
DOE/PC/79928– T7	14:33069	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012586/JAW	MF-108
DOE/PC/80014– T1	14:33358	NTIS, PC A13/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89009888/JAW	PC-108; STD-108
DOE/PC/80015– T4	14:33349	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013680/JAW	MF-108
DOE/PC/81002– T20	14:33437	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89007186/JAW	PC-105; STD-105
DOE/PC/81012– T1-Pt.1-B	14:33438	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012482/JAW	PC-105; STD-105

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T1-Pt.3	14:33439	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012530/JAW	PC-105; STD-105
T1-Pt.4	14:33440	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012529/JAW	PC-105; STD-105
T1-Pt.5	14:33441	NTIS, PC A10/MF A01 - OSTI		DE89011870/JAW	PC-105; STD-105
DOE/PC/88750–					
T1	14:33430	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89011367/JAW	MF-104
DOE/PC/88810–					
1	14:33070	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013801/JAW	MF-108
DOE/PC/88811–					
T1	14:33071	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014655/JAW	MF-108
DOE/PC/88812–					
T2	14:33072	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89011372/JAW	MF-108
DOE/PC/88813–					
T2	14:33073	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012591/JAW	MF-108
DOE/PC/88814–					
T2	14:33074	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013515/JAW	MF-108
DOE/PC/88817–					
T1	14:33075	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014657/JAW	MF-108
T2	14:33076	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014656/JAW	MF-108
DOE/PC/88941–					
T2	14:33121	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012941/JAW	MF-102
DOE/PC/90013–					
T8	14:33359	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013783/JAW	MF-108
DOE/PC/90538–					
11	14:33077	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013781/JAW	MF-102
DOE/PC/90959–					
T9	14:33135	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012399/JAW	MF-114
DOE/PETC/TR–					
89/2	14:33122	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89004636/JAW	PC-102; STD-102
DOE/RW–					
0219	14:33261	OSTI		TI89012868/JAW	MF-800
0236	14:33262	OSTI		TI89012865/JAW	MF-800
DP-MS–					
88-62	14:34457	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014083/JAW	MF-702
DPST–					
86-801	14:34488	NTIS, PC A09/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013168/JAW	MF-702
88-626	14:33263	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013673/JAW	MF-721
DPSTOM–					
81	14:34715	NTIS, PC A09/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013806/JAW	MF-700
EC/IWD–					
1988AP	14:33372	Water Survey of Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, Canada K1A 0E7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
1988BC	14:33373	Water Survey of Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, Canada K1A 0E7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
1988MB	14:33374	Water Survey of Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, Canada K1A 0E7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
1988O	14:33375	Water Survey of Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, Canada K1A 0E7;MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
ECN–					
89-057	14:33428	Netherlands Energy Research Foundation ECN, P.O. Box 1, 1755 ZG Petten, Netherlands			ND-000
89-065	14:33140	Netherlands Energy Research Foundation ECN, P.O. Box 1, 1755 ZG Petten, Netherlands			ND-000

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ECS-SR–					
41	14:34488	*See* DPST–86-801			
ECTB–					
102-01A	14:33169	*See* PB–89-137335/XAB			
103-21A	14:34387	*See* PB–89-137012/XAB			
105-13A	14:34388	*See* PB–89-137020/XAB			
106-16A	14:34389	*See* PB–89-137038/XAB			
106-17A	14:34390	*See* PB–89-137046/XAB			
106-18A	14:34395	*See* PB–89-137368/XAB			
108-12A	14:34396	*See* PB–89-137376/XAB			
108-15A	14:34401	*See* PB–89-137806/XAB			
108-24A	14:34402	*See* PB–89-137863/XAB			
108-25A	14:34403	*See* PB–89-137871/XAB			
108-26A	14:34404	*See* PB–89-137889/XAB			
108-28A	14:34405	*See* PB–89-137897/XAB			
120-11A	14:34411	*See* PB–89-139240/XAB			
120-12A	14:34412	*See* PB–89-139257/XAB			
120-13A	14:34413	*See* PB–89-139265/XAB			
146-13B	14:34391	*See* PB–89-137152/XAB			
EGG-M–					
13387	14:33264	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89011129/JAW	MF-502
EML–					
519	14:34468	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013159/JAW	MF-402
EMR/CRL–					
88-33	14:34072	Canada Centre for Mineral and Energy Technology, Technical Information Division, 555 Booth St., Rm. 342, Ottawa, ON, Canada K1A 0G1; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
88-48	14:33207	Canada Centre for Mineral and Energy Technology, Technical Information Division, 555 Booth St., Rm. 342, Ottawa, ON, Canada K1A 0G1; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
EMR/MTL–					
88-29	14:33848	Canada Centre for Mineral and Energy Technology, Technical Information Division, 555 Booth St., Rm. 342, Ottawa, ON, Canada K1A 0G1; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
EPA–					
450/2-88/006B	14:34406	*See* PB–89-138457/XAB			
450/3-88/010	14:34407	*See* PB–89-138689/XAB			
530/SW-88/031B	14:33762	*See* PB–89-142368/XAB			
530/SW-88/031C	14:33763	*See* PB–89-142376/XAB			
530/SW-88/031R	14:33764	*See* PB–89-142525/XAB			
540/1-88/001	14:34480	*See* PB–89-135859/XAB			
600/X-86/292	14:34708	*See* PB–89-138838/XAB			
910/9-88/218	14:33177	*See* PB–89-139042/XAB			
EPA/AA/CTAB–					
88/11	14:33794	*See* PB–89-138663/XAB			
EPA/AA/TEB–					
88/01	14:33797	*See* PB–89-138671/XAB			
EPRI-CS–					
3862-Vol.4	14:33442	Research Reports Center, Box 50490, Palo Alto, CA 94303			ND-000
EPRI-ER–					
6354	14:34170	Research Reports Center, Box 50490, Palo Alto, CA 94303			ND-000
EPRI-GS–					
6396-Vol.1	14:33443	Research Reports Center, Box 50490, Palo Alto CA 94303			ND-000
6396-Vol.2	14:33444	Research Reports Center, Box 50490, Palo Alto, CA 94303			ND-000
6401	14:33665	Research Reports Center, Box 50490, Palo Alto, CA 94303			ND-000
6402-Vol.1	14:33141	Research Reports Center, Box 50490, Palo Alto, CA 94303			ND-000

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EPRI-GS–					
6402-Vol.2	14:33142	Research Reports Center, Box 50490, Palo Alto, CA 94303			ND-000
6404	14:33445	Research Reports Center, Box 50490, Palo Alto, CA 94303			ND-000
6431	14:33128	Research Reports Center, Box 50490, Palo Alto, CA 94303			ND-000
EPRI-NP–					
6356-M	14:33480	Research Reports Center, Box 50490, Palo Alto, CA 94303			ND-000
6361	14:33481	Research Reports Center, Box 50490, Palo Alto, CA 94303			ND-000
6387	14:33460	Research Reports Center, Box 50490, Palo Alto, CA 94303			ND-000
6390	14:33533	Research Reports Center, Box 50490, Palo Alto, CA 94303			ND-000
ESC-WR–					
88-28	14:33652	Netherlands Energy Research Foundation ECN, P.O. Box 1, 1755 ZG Petten, Netherlands			ND-000
89-01	14:35507	Netherlands Energy Research Foundation ECN, P.O. Box 1, 1755 ZG Petten, Netherlands			ND-000
89-02	14:33646	Netherlands Energy Research Foundation ECN, P.O. Box 1, 1755 ZG Petten, Netherlands			ND-000
89-05	14:33431	Netherlands Energy Research Foundation ECN, P.O. Box 1, 1755 ZG Petten, Netherlands			ND-000
89-06	14:33640	Netherlands Energy Research Foundation ECN, P.O. Box 1, 1755 ZG Petten, Netherlands			ND-000
89-07	14:34384	Netherlands Energy Research Foundation ECN, P.O. Box 1, 1755 ZG Petten, Netherlands			ND-000
ESG–					
60	14:34247	*See* LBL–25958			
ETY–					
22/1989	14:33432	NTIS (US Sales Only), PC A04/MF A01;1		DE89776170/JAW	MF-000
EUR–					
11729-DE	14:33078	Commission of the European Communities, Luxembourg			ND-000
11801	14:33265	NTIS (US Sales Only), PC A08/MF A01			MF-000
11843	14:33079	European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037			ND-000
FNAL-TM–					
1586	14:34282	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013723/JAW	PC-414
1589	14:34283	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013725/JAW	PC-414
1590	14:34240	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013724/JAW	PC-414
1592	14:34322	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013722/JAW	PC-414
1594	14:34284	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013386/JAW	PC-414
1596	14:34285	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014633/JAW	PC-414
FNAL/C–					
89/118	14:35486	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014811/JAW	MF-405
89/26	14:34962	NTIS, PC A03/MF A01 - OSTI		DE89014215/JAW	MF-414
FRNC-TH–					
3411	14:33515	NTIS (US Sales Only), PC A10/MF A01		DE89781579/JAW	MF-000
3471	14:34672	NTIS (US Sales Only), PC A11/MF A01		DE89781575/JAW	MF-000
FSU-SCRI–					
89-39	14:35022	*See* NBI-HE–89-19			
FTUV–					
04/89	14:33902	*See* RAL–89-015			
GA-A–					
19667	14:35410	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013026/JAW	MF-421
GANIL-A–					
88-01	14:34241	NTIS (US Sales Only), PC A02/MF A01		DE89781548/JAW	MF-000
88-02	14:35202	NTIS (US Sales Only), PC A02/MF A01		DE89781543/JAW	MF-000
88-03	14:34286	NTIS (US Sales Only), PC A02/MF A01		DE89781546/JAW	MF-000
88-05	14:34287	NTIS (US Sales Only), PC A02/MF A01		DE89781542/JAW	MF-000
88-06	14:34225	NTIS (US Sales Only), PC A03/MF A01		DE89781490/JAW	MF-000
GANIL-P–					
88-05	14:34900	NTIS (US Sales Only), PC A03/MF A01		DE89781541/JAW	MF-000
88-11	14:35091	NTIS (US Sales Only), PC A03/MF A01		DE89781590/JAW	MF-000
89-01	14:34323	NTIS (US Sales Only), PC A03/MF A01		DE89781596/JAW	MF-000
GANIL-T–					
87-03	14:34901	NTIS (US Sales Only), PC A06/MF A01		DE89781504/JAW	MF-000

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
GCLL–					
8804	14:34054	Canada Centre for Mineral and Energy Technology, Technical Information Division, 555 Booth St., Rm. 342, Ottawa, , Canada K1A 0G1; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
GKSS–					
88/E/58	14:34171	Special print from Chem. Eng. Commun. (1987) v. 54 p. 119-138.			MF-000
GRI–					
88/0160	14:33688	*See* LBL–25492			
89/0060	14:33689	*See* LBL–27025			
GRS–					
379(1)	14:33673	NTIS (US Sales Only), PC A03/MF A01;1		DE89776215/JAW	MF-000
68	14:33570	Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Garching (Germany, F.R.)			ND-000
70	14:34121	NTIS (US Sales Only), PC A05/MF A01		DE89783262/JAW	MF-000
HD-THEP–					
88-5	14:34963	Heidelberg Univ. (Germany, F.R.). Inst. fuer Theoretische Physik			ND-000
HETA–					
77-000-063	14:34423	*See* PB–89-140297/XAB			
78-000-012	14:34399	*See* PB–89-137509/XAB			
86-447-1919	14:34422	*See* PB–89-140271/XAB			
86-461-1920	14:34421	*See* PB–89-140263/XAB			
87-112-1922	14:34410	*See* PB–89-139232/XAB			
87-307-1917	14:34420	*See* PB–89-140255/XAB			
HHE–					
74-024-246	14:34400	*See* PB–89-137517/XAB			
74-097-286	14:34409	*See* PB–89-138994/XAB			
75-181-287	14:34419	*See* PB–89-140230/XAB			
76-018-288	14:34418	*See* PB–89-140214/XAB			
76-043-429	14:34417	*See* PB–89-140206/XAB			
76-054-436	14:34416	*See* PB–89-140198/XAB			
76-115-425	14:34408	*See* PB–89-138713/XAB			
77-027-437	14:34397	*See* PB–89-137434/XAB			
77-047-427	14:33170	*See* PB–89-137459/XAB			
77-058-428	14:34398	*See* PB–89-137467/XAB			
HIFAN–					
397	14:35457	*See* LBL–25432			
408	14:35461	*See* LBL–25998			
409	14:35460	*See* LBL–25995			
415	14:35462	*See* LBL–26167			
419	14:35463	*See* LBL–26482			
HIFT–					
144	14:35411	NTIS (US Sales Only), PC A03/MF A01		DE89778170/JAW	MF-000
146	14:35412	NTIS (US Sales Only), PC A03/MF A01		DE89778171/JAW	MF-000
148	14:35413	NTIS (US Sales Only), PC A03/MF A01		DE89778172/JAW	MF-000
HW–					
28121	14:33266	NTIS, PC A03/MF A01 - OSTI		DE89013137/JAW	MF-603
33452	14:33571	NTIS, PC A03/MF A01 - OSTI		DE89013136/JAW	MF-731
IAE–					
4545/15	14:35414	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89617633/JAW	MF-000
4677/1	14:35203	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89618624/JAW	MF-000
IAEA-AL–					
006	14:34055	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89619119/JAW	MF-000
011	14:35476	NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS		DE89620460/JAW	MF-000
012	14:34056	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89617880/JAW	MF-000
IAEA-INFCIRC–					
1(Rev.9)	14:35477	NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS		DE89620461/JAW	MF-000
351(Add.1)	14:33516	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89620441/JAW	MF-000
IAEA-R–					
2927-F	14:35447	NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS		DE89617686/JAW	MF-000
3441-F	14:34673	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89618008/JAW	MF-000
IAEA-TECDOC–					
480	14:33572	NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS		DE89617155/JAW	MF-000
486	14:33350	NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS		DE89617908/JAW	MF-000
487	14:33232	NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS		DE89618148/JAW	MF-000
489	14:33461	NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS		DE89618207/JAW	MF-000
492	14:33218	NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS		DE89617917/JAW	MF-000

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
493	14:34523	NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS		DE89618103/JAW	MF-000
494	14:34469	NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS		DE89618054/JAW	MF-000
496	14:34632	NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS		DE89618013/JAW	MF-000
497	14:33455	NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS		DE89618203/JAW	MF-000
498	14:33456	NTIS (US Sales Only), PC A09/MF A01 - OSTI; INIS		DE89620239/JAW	MF-000
IBK–					
1602	14:35191	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89618135/JAW	MF-000
1603	14:34073	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89617898/JAW	MF-000
1606	14:33534	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89618192/JAW	MF-000
IC–					
88/227	14:34902	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89618514/JAW	MF-000
88/289	14:35204	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89617620/JAW	MF-000
88/291	14:35205	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89617600/JAW	MF-000
88/293	14:35249	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89618376/JAW	MF-000
88/329	14:35250	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89617522/JAW	MF-000
88/339	14:35241	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89617777/JAW	MF-000
88/340	14:35242	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89617778/JAW	MF-000
88/344	14:34964	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89617793/JAW	MF-000
88/353	14:35251	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89618392/JAW	MF-000
88/366	14:35243	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89617779/JAW	MF-000
88/376	14:35206	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89617601/JAW	MF-000
88/383	14:35252	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89618377/JAW	MF-000
88/384	14:35415	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89618689/JAW	MF-000
88/385	14:35253	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89618378/JAW	MF-000
88/399	14:34885	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89619725/JAW	MF-000
88/403	14:35254	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89617523/JAW	MF-000
88/404	14:35255	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89618380/JAW	MF-000
88/409	14:35256	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89617524/JAW	MF-000
88/410	14:35257	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89618381/JAW	MF-000
88/413	14:34931	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89618886/JAW	MF-000
88/415	14:35175	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89617843/JAW	MF-000
88/416	14:35258	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89617529/JAW	MF-000
88/417	14:35259	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89618393/JAW	MF-000
88/419	14:35260	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89617525/JAW	MF-000
88/420	14:35261	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89618382/JAW	MF-000
88/421	14:35207	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89618548/JAW	MF-000
88/422	14:35114	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89618974/JAW	MF-000
88/425	14:34903	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89617587/JAW	MF-000
88/427	14:35244	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89618864/JAW	MF-000
88/428	14:35262	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89618383/JAW	MF-000
88/429	14:35263	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89618384/JAW	MF-000
88/430	14:35264	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89618426/JAW	MF-000
89/1	14:35265	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89618385/JAW	MF-000
89/10	14:35269	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89618394/JAW	MF-000
89/11	14:35245	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89618865/JAW	MF-000
89/12	14:35270	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89618395/JAW	MF-000
89/13	14:35271	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89618386/JAW	MF-000
89/14	14:35116	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89618975/JAW	MF-000
89/15	14:35416	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89617674/JAW	MF-000
89/16	14:34470	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89619867/JAW	MF-000
89/2	14:34794	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89618786/JAW	MF-000
89/22	14:35272	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89618387/JAW	MF-000
89/23	14:34886	NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS		DE89619726/JAW	MF-000
89/27	14:35117	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89618977/JAW	MF-000
89/3	14:35266	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89618427/JAW	MF-000
89/36	14:34887	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89619727/JAW	MF-000
89/38	14:35007	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89618459/JAW	MF-000
89/4	14:35267	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89618428/JAW	MF-000
89/44	14:35273	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89618396/JAW	MF-000
89/47	14:35008	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89618460/JAW	MF-000
89/5	14:35005	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89618461/JAW	MF-000
89/6	14:35268	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89617530/JAW	MF-000
89/8	14:35115	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89619005/JAW	MF-000
89/9	14:35006	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89618462/JAW	MF-000
IFT-P–					
27/88	14:35274	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89618429/JAW	MF-000
28/88	14:35275	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89618430/JAW	MF-000
33/88	14:35276	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89618431/JAW	MF-000
IFUSP-P–					
703	14:35208	NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS		DE89618625/JAW	MF-000
723	14:34965	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89618942/JAW	MF-000

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
727	14:35118	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89618978/JAW	MF-000
729	14:34966	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89618891/JAW	MF-000
730	14:35050	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89619060/JAW	MF-000
731	14:34997	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89618506/JAW	MF-000
734	14:34967	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89618910/JAW	MF-000
738	14:35277	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89618397/JAW	MF-000
739	14:34998	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89618507/JAW	MF-000
741	14:35009	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89618463/JAW	MF-000
742	14:35278	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89618398/JAW	MF-000
744	14:35119	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89619006/JAW	MF-000
746	14:35010	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89618464/JAW	MF-000
748	14:35067	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89619079/JAW	MF-000
751	14:35120	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89619008/JAW	MF-000
752	14:34968	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89618943/JAW	MF-000
753	14:35121	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89619009/JAW	MF-000
754	14:35122	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89618979/JAW	MF-000
755	14:34969	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89618944/JAW	MF-000
756	14:35279	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89618399/JAW	MF-000
757	14:35011	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89618465/JAW	MF-000
758	14:35051	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89619061/JAW	MF-000
759	14:35123	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89619010/JAW	MF-000
IFVE-ONF–					
88-52	14:34324	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89620304/JAW	MF-000
IFVE-OTF–					
88-110	14:35487	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89620449/JAW	MF-000
IFVE-OUNK–					
88-11	14:34288	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89620138/JAW	MF-000
IKE–					
4-124	14:33722	NTIS (US Sales Only), PC A07;3		DE89783022/JAW	MF-000
INDC(CCP)–					
297/GE	14:35124	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89618980/JAW	MF-000
298/L	14:35125	NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS		DE89619041/JAW	MF-000
INDC(GDR)–					
50/L	14:35126	NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS		DE89617851/JAW	MF-000
INDC(GER)–					
033/GX	14:35069	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89617870/JAW	MF-000
INDC(JPN)–					
120/L	14:33531	*See* JAERI-M–89-026			
INFN-LNF–					
89-008(PT)	14:34970	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89612645/JAW	MF-000
INFO–					
0246	14:33267	NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS		DE89620405/JAW	MF-000
0256	14:33268	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89620406/JAW	MF-000
0260	14:34675	NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS		DE89619828/JAW	MF-000
INIS-BR–					
1536	14:34722	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89619120/JAW	MF-000
1537	14:34723	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89619121/JAW	MF-000
1538	14:34756	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89619122/JAW	MF-000
1543	14:34724	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89619124/JAW	MF-000
1545	14:34759	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89619694/JAW	MF-000
1546	14:34760	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89619695/JAW	MF-000
1547	14:34172	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89620089/JAW	MF-000
1548	14:34795	NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS		DE89618825/JAW	MF-000
1550	14:33521	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89620440/JAW	MF-000
INIS-GB–					
190	14:35471	NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS		DE89620462/JAW	MF-000
INIS-SU–					
90	14:34999	NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS		DE89618508/JAW	MF-000
91	14:35289	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89618388/JAW	MF-000
INIS-XN–					
174	14:33269	NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS		DE89618318/JAW	MF-000
175	14:33270	NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS		DE89618319/JAW	MF-000
176	14:33271	NTIS (US Sales Only), PC A10/MF A01 - OSTI; INIS		DE89618320/JAW	MF-000
177	14:33272	NTIS (US Sales Only), PC A20/MF A01 - OSTI; INIS		DE89618321/JAW	MF-000
178	14:33273	NTIS (US Sales Only), PC A11/MF A01 - OSTI; INIS		DE89618322/JAW	MF-000
179	14:33274	NTIS (US Sales Only), PC A14/MF A01 - OSTI; INIS		DE89618323/JAW	MF-000
180	14:33275	NTIS (US Sales Only), PC A14/MF A01 - OSTI; INIS		DE89618324/JAW	MF-000
181	14:33276	NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS		DE89618325/JAW	MF-000
183	14:33582	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89618193/JAW	MF-000
INIS-mf–					
11396	14:35127	NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS		DE89615754/JAW	MF-000

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
11425	14:33482	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89618210/JAW	MF-000
11428	14:33801	NTIS (US Sales Only), PC A09/MF A01 - OSTI; INIS		DE89618365/JAW	MF-000
11443	14:35417	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89617632/JAW	MF-000
11450	14:34796	NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS		DE89617701/JAW	MF-000
11452	14:33246	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89618162/JAW	MF-000
11453	14:33483	NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS		DE89618211/JAW	MF-000
11454	14:34122	NTIS (US Sales Only), PC A10/MF A01 - OSTI; INIS		DE89617941/JAW	MF-000
11455	14:33457	NTIS (US Sales Only), PC A12/MF A01 - OSTI; INIS		DE89618204/JAW	MF-000
11457(v.1,2)	14:33329	NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS		DE89619926/JAW	MF-000
11463	14:34471	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89619840/JAW	MF-000
11465	14:34472	NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS		DE89619876/JAW	MF-000
11466	14:35478	NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS		DE89620472/JAW	MF-000
11960	14:34683	NTIS (US Sales Only), PC A06/MF A01		DE89783070/JAW	MF-000
11961	14:34607	NTIS (US Sales Only), PC A04/MF A01		DE89783071/JAW	MF-000
11962	14:34608	NTIS (US Sales Only), PC A04/MF A01		DE89783072/JAW	MF-000
11963	14:34609	NTIS (US Sales Only), PC A08/MF A01		DE89783073/JAW	MF-000
11964	14:34610	NTIS (US Sales Only), PC A05/MF A01		DE89783074/JAW	MF-000
11965	14:34611	NTIS (US Sales Only), PC A03/MF A01		DE89783075/JAW	MF-000
11966	14:34612	NTIS (US Sales Only), PC A04/MF A01		DE89783076/JAW	MF-000
11967	14:34684	NTIS (US Sales Only), PC A04/MF A01		DE89783077/JAW	MF-000
11968	14:34613	NTIS (US Sales Only), PC A06/MF A01		DE89783078/JAW	MF-000
11969	14:34614	NTIS (US Sales Only), PC A04/MF A01		DE89783057/JAW	MF-000
11970	14:34615	NTIS (US Sales Only), PC A04/MF A01		DE89783058/JAW	MF-000
11971	14:34616	NTIS (US Sales Only), PC A06/MF A01		DE89783059/JAW	MF-000
11972	14:34685	NTIS (US Sales Only), PC A06/MF A01		DE89783060/JAW	MF-000
11973	14:34617	NTIS (US Sales Only), PC A04/MF A01		DE89783061/JAW	MF-000
11974	14:34618	NTIS (US Sales Only), PC A06/MF A01		DE89783062/JAW	MF-000
11975	14:34619	NTIS (US Sales Only), PC A05/MF A01		DE89783063/JAW	MF-000
11976	14:34620	NTIS (US Sales Only), PC A03/MF A01		DE89783064/JAW	MF-000
11977	14:34621	NTIS (US Sales Only), PC A05/MF A01		DE89783065/JAW	MF-000
11978	14:34622	NTIS (US Sales Only), PC A04/MF A01		DE89783066/JAW	MF-000
11979	14:34623	NTIS (US Sales Only), PC A05/MF A01		DE89783067/JAW	MF-000
11980	14:34518	NTIS (US Sales Only), PC A05/MF A01		DE89783068/JAW	MF-000
11981	14:34624	NTIS (US Sales Only), PC A04/MF A01		DE89783069/JAW	MF-000
11982	14:33458	NTIS (US Sales Only), PC A99/MF A01		DE89783126/JAW	MF-000
INS–					
718	14:34289	NTIS (US Sales Only), PC A03/MF A01		DE89778052/JAW	MF-000
720	14:35000	NTIS (US Sales Only), PC A03/MF A01		DE89778086/JAW	MF-000
721	14:34858	NTIS (US Sales Only), PC A03/MF A01		DE89778087/JAW	MF-000
723	14:35036	NTIS (US Sales Only), PC A03/MF A01		DE89778088/JAW	MF-000
724	14:35044	NTIS (US Sales Only), PC A03/MF A01		DE89778089/JAW	MF-000
726	14:34290	NTIS (US Sales Only), PC A03/MF A01		DE89778130/JAW	MF-000
727	14:34859	NTIS (US Sales Only), PC A03/MF A01		DE89778131/JAW	MF-000
728	14:34328	NTIS (US Sales Only), PC A03/MF A01		DE89778132/JAW	MF-000
729	14:35045	NTIS (US Sales Only), PC A03/MF A01		DE89778133/JAW	MF-000
731	14:35092	NTIS (US Sales Only), PC A03/MF A01		DE89778134/JAW	MF-000
IPEN-PUB–					
214	14:34057	NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS		DE89617882/JAW	MF-000
IPNO-DRE–					
87-33(1)	14:35223	NTIS (US Sales Only), PC A02/MF A01		DE89781421/JAW	MF-000
87-33(2)	14:35224	NTIS (US Sales Only), PC A02/MF A01		DE89781422/JAW	MF-000
87-33(3)	14:34329	NTIS (US Sales Only), PC A02/MF A01		DE89781423/JAW	MF-000
87-33(4)	14:34330	NTIS (US Sales Only), PC A02/MF A01		DE89781424/JAW	MF-000
87-33(5)	14:35225	NTIS (US Sales Only), PC A03/MF A01		DE89781427/JAW	MF-000
87-33(6)	14:35226	NTIS (US Sales Only), PC A03/MF A01		DE89781425/JAW	MF-000
87-36	14:35149	NTIS (US Sales Only), PC A03/MF A01		DE89781510/JAW	MF-000
87-39	14:35059	NTIS (US Sales Only), PC A03/MF A01		DE89781506/JAW	MF-000
87-41	14:35150	NTIS (US Sales Only), PC A03/MF A01		DE89781511/JAW	MF-000
87-43	14:34058	NTIS (US Sales Only), PC A04/MF A01		DE89781509/JAW	MF-000
88-03	14:35041	NTIS (US Sales Only), PC A02/MF A01		DE89781600/JAW	MF-000
88-06	14:35072	NTIS (US Sales Only), PC A03/MF A01		DE89781594/JAW	MF-000
88-07	14:35073	NTIS (US Sales Only), PC A03/MF A01		DE89781598/JAW	MF-000
88-10	14:35085	NTIS (US Sales Only), PC A03/MF A01		DE89781601/JAW	MF-000
88-18	14:35151	NTIS (US Sales Only), PC A03/MF A01		DE89781531/JAW	MF-000
88-39	14:34331	NTIS (US Sales Only), PC A03/MF A01		DE89781566/JAW	MF-000
IPNO-TH–					
87-81	14:35013	NTIS (US Sales Only), PC A03/MF A01		DE89781493/JAW	MF-000
87-83	14:34951	NTIS (US Sales Only), PC A03/MF A01		DE89781492/JAW	MF-000
88-3	14:35037	NTIS (US Sales Only), PC A03/MF A01		DE89781489/JAW	MF-000
IPPJ–					
867	14:35418	NTIS (US Sales Only), PC A03/MF A01			MF-000

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
IPPT-IFTR–					
19/1985	14:35422	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89618729/JAW	MF-000
7/1985	14:35421	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89618730/JAW	MF-000
IREQ–					
145T327	14:33453	Canadian Electrical Association, Research & Development, Suite #500, One Westmount Square, Montreal, PQ, Canada H3Z 2P9; $75.00 NON MEMBERS; MEMBERS: PRICES UPON REQUEST, FUNDS CAN.			ND-000
ISH–					
118	14:34663	Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene			ND-000
126	14:34686	Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene			ND-000
ISN–					
87-75	14:35152	NTIS (US Sales Only), PC A03/MF A01		DE89781516/JAW	MF-000
87-83	14:34332	NTIS (US Sales Only), PC A02/MF A01		DE89781517/JAW	MF-000
87-95	14:35181	NTIS (US Sales Only), PC A03/MF A01		DE89781518/JAW	MF-000
87-96	14:35153	NTIS (US Sales Only), PC A03/MF A01		DE89781501/JAW	MF-000
87-97	14:34944	NTIS (US Sales Only), PC A03/MF A01		DE89781513/JAW	MF-000
IWS–					
134.20.10	14:34415	*See* PB–89-140180/XAB			
IYaF–					
88-79	14:35154	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89618985/JAW	MF-000
88-94	14:34242	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89620117/JAW	MF-000
JAERI-M–					
88-155	14:34244	NTIS (US Sales Only), PC A04/MF A01		DE89778012/JAW	MF-000
88-238	14:33984	NTIS (US Sales Only), PC A03/MF A01		DE89778069/JAW	MF-000
88-241	14:35451	NTIS (US Sales Only), PC A03/MF A01		DE89778090/JAW	MF-000
88-244	14:33520	NTIS (US Sales Only), PC A03/MF A01		DE89778070/JAW	MF-000
88-246	14:35452	NTIS (US Sales Only), PC A03/MF A01		DE89778091/JAW	MF-000
88-248	14:33339	NTIS (US Sales Only), PC A09/MF A01		DE89778127/JAW	MF-000
88-250	14:33550	NTIS (US Sales Only), PC A05/MF A01		DE89778092/JAW	MF-000
88-251	14:35453	NTIS (US Sales Only), PC A14/MF A01		DE89778110/JAW	MF-000
88-252	14:35109	NTIS (US Sales Only), PC A11/MF A01		DE89778111/JAW	MF-000
88-253	14:35454	NTIS (US Sales Only), PC A03/MF A01		DE89778112/JAW	MF-000
88-254	14:35455	NTIS (US Sales Only), PC A03/MF A01		DE89778093/JAW	MF-000
88-255	14:33551	NTIS (US Sales Only), PC A07/MF A01		DE89778094/JAW	MF-000
88-256	14:33583	NTIS (US Sales Only), PC A04/MF A01		DE89778095/JAW	MF-000
88-263	14:33528	NTIS (US Sales Only), PC A04/MF A01		DE89778096/JAW	MF-000
88-264	14:33885	NTIS (US Sales Only), PC A03/MF A01		DE89778128/JAW	MF-000
88-268	14:35456	NTIS (US Sales Only), PC A07/MF A01		DE89778129/JAW	MF-000
89-026	14:33531	Japan Atomic Energy Research Institute, Tokai-mura, Naka-gun, Ibaraki-ken 319-11, Japan			MF-000
JET-R–					
88-07	14:35423	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89618702/JAW	MF-000
JINR–					
13-88-345	14:33552	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89620274/JAW	MF-000
13-88-391	14:34333	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89620297/JAW	MF-000
13-88-468	14:34334	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89620307/JAW	MF-000
13-88-486	14:34293	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89620128/JAW	MF-000
13-88-512	14:34335	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89620308/JAW	MF-000
13-88-575	14:34294	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89620151/JAW	MF-000
13-88-577	14:34336	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89620309/JAW	MF-000
13-88-589	14:34363	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89620335/JAW	MF-000
13-88-618	14:34337	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89620310/JAW	MF-000
13-88-619	14:34338	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89620311/JAW	MF-000
14-88-535	14:35227	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89618626/JAW	MF-000
16-88-524	14:35193	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89619956/JAW	MF-000
18-88-439	14:33886	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89619605/JAW	MF-000
9-88-396	14:34230	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89620105/JAW	MF-000
9-88-533	14:34292	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89620129/JAW	MF-000
JINR-D–					
1-88-368	14:34952	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89618956/JAW	MF-000
1-88-369	14:34953	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89618957/JAW	MF-000
JINR-E–					
1-88-450	14:35155	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89619001/JAW	MF-000
14-88-429	14:35228	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89618553/JAW	MF-000
14-88-430	14:35229	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89618554/JAW	MF-000
2-88-395	14:34975	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89618894/JAW	MF-000
2-88-421	14:35014	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89618466/JAW	MF-000

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
JINR-E-					
2-88-428	14:34976	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89618912/JAW	MF-000
2-88-460	14:34977	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89618913/JAW	MF-000
2-88-465	14:34978	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89618914/JAW	MF-000
2-88-474	14:35015	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89618467/JAW	MF-000
2-88-519	14:34979	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89618915/JAW	MF-000
2-88-543	14:35016	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89618468/JAW	MF-000
2-88-655	14:35017	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89618469/JAW	MF-000
4-88-228	14:35156	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89618986/JAW	MF-000
4-88-610	14:34980	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89618916/JAW	MF-000
5-88-456	14:35290	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89618402/JAW	MF-000
7-88-650	14:35038	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89619054/JAW	MF-000
9-88-445	14:34295	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89620125/JAW	MF-000
JINR-R-					
1-88-327	14:34981	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89618917/JAW	MF-000
1-88-393	14:35046	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89619057/JAW	MF-000
1-88-443	14:35047	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89619058/JAW	MF-000
1-88-520	14:35074	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89619083/JAW	MF-000
1-88-523	14:34339	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89620306/JAW	MF-000
1-88-592	14:35048	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89619059/JAW	MF-000
1-88-703	14:35093	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89619103/JAW	MF-000
10-88-381	14:34364	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89620334/JAW	MF-000
10-88-432	14:35489	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89620452/JAW	MF-000
10-88-455	14:34340	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89620295/JAW	MF-000
13-88-346	14:33553	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89620273/JAW	MF-000
14-88-440	14:33887	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89619604/JAW	MF-000
17-88-349	14:35295	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89618403/JAW	MF-000
2-88-364	14:34982	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89618895/JAW	MF-000
2-88-441	14:35291	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89618404/JAW	MF-000
2-88-483	14:35292	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89618432/JAW	MF-000
2-88-501	14:34983	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89618918/JAW	MF-000
2-88-544	14:35001	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89618509/JAW	MF-000
2-88-556	14:34984	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89618919/JAW	MF-000
2-88-626	14:35293	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89618433/JAW	MF-000
4-88-438	14:35294	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89618405/JAW	MF-000
4-88-447	14:35230	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89618555/JAW	MF-000
4-88-509	14:35157	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89619037/JAW	MF-000
4-88-612	14:35158	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89619020/JAW	MF-000
6-88-562	14:35075	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89619084/JAW	MF-000
6-88-563	14:35076	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89619085/JAW	MF-000
9-88-365	14:34296	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89620142/JAW	MF-000
9-88-424	14:34245	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89620121/JAW	MF-000
9-88-472	14:34297	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89620143/JAW	MF-000
9-88-508	14:34298	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89620136/JAW	MF-000
9-88-542	14:34299	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89620149/JAW	MF-000
9-88-644	14:34300	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89620144/JAW	MF-000
9-88-675	14:34301	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89620150/JAW	MF-000
Juel-Spez-					
481	14:35061	NTIS (US Sales Only), PC A06/MF A01		DE89783052/JAW	MF-000
482	14:35077	NTIS (US Sales Only), PC A05/MF A01		DE89783051/JAW	MF-000
K/QT-					
301	14:33277	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013522/JAW	MF-513
K/SS-					
528	14:34123	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013773/JAW	MF-513
KAPL-					
4709	14:34505	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014684/JAW	MF-507; MN-502
KEK-					
88-3	14:35182	NTIS (US Sales Only), PC A08/MF A01		DE89012146/JAW	MF-000
88-8	14:34313	NTIS (US Sales Only), PC A03/MF A01		DE89778071/JAW	MF-000
KFK-					
4519	14:34434	NTIS (US Sales Only), PC A05/MF A01		DE89783050/JAW	MF-000
4551	14:35053	NTIS (US Sales Only), PC A06/MF A01		DE89783053/JAW	MF-000
KFKI-					
1988-67/G	14:33489	NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS		DE89620246/JAW	MF-000
1988-70/G	14:33490	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89620247/JAW	MF-000
1988-72/G	14:33491	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89620248/JAW	MF-000
1988-73/G	14:33492	NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS		DE89620249/JAW	MF-000
1988-74/H	14:34345	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89620320/JAW	MF-000
KIYI-					
87-40	14:35159	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89617853/JAW	MF-000

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KTM/E-D–					
161	14:33653	NTIS (US Sales Only), PC A06/MF A01;1		DE89776164/JAW	MF-000
164	14:33642	NTIS (US Sales Only), PC A08/MF A01;1		DE89776163/JAW	MF-000
165	14:34385	NTIS (US Sales Only), PC A03/MF A01;1		DE89776161/JAW	MF-000
166	14:33757	NTIS (US Sales Only), PC A08/MF A01;1		DE89776162/JAW	MF-000
167	14:33446	NTIS (US Sales Only), PC A08/MF A01;1		DE89776182/JAW	MF-000
LA–					
11615-MS	14:33330	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013338/JAW	MF-700
LA-UR–					
89-5	14:34125	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89006543/JAW	MF-706
89-1000	14:33800	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012870/JAW	PC-700
89-1305	14:34458	NTIS, PC A02/MF A01 - OSTI		DE89011174/JAW	MF-000
89-1486	14:35231	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012654/JAW	MF-701
89-1593	14:34864	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012621/JAW	MF-412
89-1715	14:33331	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013440/JAW	MF-700
89-1772	14:33517	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013460/JAW	MF-15
89-1776	14:33332	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013459/JAW	MF-15
89-1791	14:34757	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013456/JAW	MF-000
89-1862	14:33333	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013465/JAW	MF-700
89-1876	14:34906	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013463/JAW	MF-420
89-490	14:34210	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89007985/JAW	MF-706
89-645	14:34761	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89008020/JAW	MF-403
89-646	14:34762	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89008019/JAW	MF-403
LAPP-EXP–					
87-08	14:34346	NTIS (US Sales Only), PC A03/MF A01		DE89781500/JAW	MF-000
88-01	14:34860	NTIS (US Sales Only), PC A02/MF A01		DE89781536/JAW	MF-000
88-04	14:34861	NTIS (US Sales Only), PC A02/MF A01		DE89781539/JAW	MF-000
LAPP-TH–					
206-87	14:34862	NTIS (US Sales Only), PC A02/MF A01		DE89781499/JAW	MF-000
210-88	14:35018	NTIS (US Sales Only), PC A02/MF A01		DE89781486/JAW	MF-000
215-88	14:34863	NTIS (US Sales Only), PC A02/MF A01		DE89781533/JAW	MF-000
217-88	14:35002	NTIS (US Sales Only), PC A03/MF A01		DE89781485/JAW	MF-000
221-88	14:35019	NTIS (US Sales Only), PC A03/MF A01		DE89781487/JAW	MF-000
LBL–					
22473	14:33724	NTIS, PC A09/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013403/JAW	MF-402; MN-407
23025	14:33674	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013370/JAW	PC-350
23026	14:33658	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013373/JAW	PC-350
23027	14:33675	NTIS, PC A12/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013404/JAW	MF-000
23035	14:33725	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013405/JAW	MF-350
23151	14:33726	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013406/JAW	MF-350
23605	14:33654	NTIS, PC A08/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012859/JAW	MF-350
23886	14:33727	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013407/JAW	MF-350
23979	14:33728	NTIS, PC A08/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013408/JAW	MF-350
24052	14:33729	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013397/JAW	MF-350
24211	14:33650	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013399/JAW	MF-210; MN-202
24216	14:33730	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013398/JAW	PC-402
24914	14:34758	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013409/JAW	MF-800
24979	14:34303	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013388/JAW	MF-414
25080	14:33731	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012831/JAW	MF-350
25211	14:33732	NTIS, PC A08/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013396/JAW	MF-402; MN-407; MN-350
25423	14:34907	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012976/JAW	MF-420
25432	14:35457	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013417/JAW	PC-411
25465	14:33733	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013394/JAW	MF-350; MN-402; MN-407
25471	14:33655	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013372/JAW	PC-350
25473	14:33666	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012854/JAW	MF-900
25492	14:33688	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013391/JAW	MF-000
25558-Rev.	14:33676	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013375/JAW	PC-350
25560	14:34075	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013691/JAW	MF-401
25587	14:34076	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013690/JAW	MF-401

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
25635	14:33425	NTIS, PC A07/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013358/JAW	MF-250
25715	14:34126	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012851/JAW	PC-406
25716	14:33710	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012852/JAW	MF-000
25718	14:33734	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012853/JAW	MF-350
25722	14:34127	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013374/JAW	PC-406
25767	14:33278	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013400/JAW	PC-815
25768	14:33279	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013371/JAW	PC-815
25770	14:35490	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013412/JAW	PC-405
25783	14:33280	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012856/JAW	MF-403
25911	14:33098	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012849/JAW	MF-109
25955	14:34246	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013686/JAW	MF-414
25958	14:34247	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013692/JAW	MF-414
25971	14:33423	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012850/JAW	MF-251
25983	14:34248	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013000/JAW	MF-414
25985	14:35458	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012980/JAW	MF-414
25989	14:35459	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013694/JAW	MF-400
25995	14:35460	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013688/JAW	MF-414
25998	14:35461	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012999/JAW	MF-414
26165	14:33667	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013368/JAW	MF-900
26166	14:33668	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013390/JAW	PC-600
26167	14:35462	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012860/JAW	MF-414
26168	14:33888	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012981/JAW	MF-404
26212	14:33669	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012857/JAW	MF-900
26246	14:34304	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013422/JAW	MF-414
26254	14:34211	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013410/JAW	MF-406
26259	14:34908	NTIS, PC A14/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013392/JAW	PC-411
26306	14:33735	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013411/JAW	MF-000
26374	14:33670	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012837/JAW	MF-350
26424	14:33099	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013413/JAW	MF-109
26438	14:34489	NTIS, PC A11/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013414/JAW	MF-000
26466	14:34945	NTIS, PC A07/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013351/JAW	PC-410
26482	14:35463	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012858/JAW	PC-411
26578	14:35246	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013395/JAW	PC-404
26583	14:33651	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012838/JAW	MF-201
26586	14:33736	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013389/JAW	PC-350
26588	14:33737	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012855/JAW	PC-400
26627	14:33773	NTIS, PC A05/MF A01 - OSTI		DE89013415/JAW	MF-000
26651	14:33889	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012979/JAW	MF-404
26669	14:34987	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013418/JAW	MF-414
26672	14:33281	NTIS, PC A03/MF A01 - OSTI		DE89013416/JAW	MF-800
26700	14:35491	NTIS, PC A03/MF A01 - OSTI		DE89013419/JAW	MF-800
26712	14:34059	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012832/JAW	MF-600; MN-350
26783-Vol.1	14:34148	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012836/JAW	PC-400
26819	14:33426	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012993/JAW	MF-251
26837	14:33738	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012846/JAW	PC-350
26850	14:33957	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012833/JAW	MF-901
26891	14:33100	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012834/JAW	MF-109
26900	14:34909	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012982/JAW	MF-414
26923	14:33613	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012845/JAW	MF-210
26952	14:33739	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012844/JAW	PC-350
26953	14:35296	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012835/JAW	MF-414
26997	14:34347	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012978/JAW	MF-414
26999	14:33614	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012839/JAW	MF-210
27025	14:33689	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012840/JAW	MF-000
27031	14:34462	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012848/JAW	PC-802
27040	14:34365	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012983/JAW	MF-408
27044	14:35492	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012842/JAW	MF-800
27064	14:33890	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012977/JAW	MF-404
27144	14:35039	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012990/JAW	MF-413
27155	14:33387	NTIS, PC A12/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012995/JAW	MF-408
27162	14:34305	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013687/JAW	MF-414
27174	14:34231	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013693/JAW	MF-414
27177	14:35094	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013695/JAW	MF-413
27206	14:33740	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012843/JAW	MF-350
LHRL-LIB/Trans–					
3	14:35194	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89618065/JAW	MF-000
LU-TP–					
88-5	14:34988	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89618922/JAW	MF-000
88-14	14:34989	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89618920/JAW	MF-000

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
88-15	14:34990	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89618921/JAW	MF-000
LUIP–					
8805	14:35078	NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS		DE89617871/JAW	MF-000
LUNFD6-NFFK–					
7088-1-107-1988	14:35078	*See* LUIP–8805			
LUNTDX-NTMX–					
1001-1-133-1988	14:34314	NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS		DE89618173/JAW	MF-000
LUTMDN-TMVK–					
5172-1-90-1988	14:33143	NTIS (US Sales Only), PC A05/MF A01;1		DE89776241/JAW	MF-000
LYCEN–					
87-47	14:34910	NTIS (US Sales Only), PC A03/MF A01		DE89781495/JAW	MF-000
87-48	14:35232	NTIS (US Sales Only), PC A02/MF A01		DE89781496/JAW	MF-000
8767	14:35020	NTIS (US Sales Only), PC A03/MF A01		DE89781497/JAW	MF-000
LYCEN-T–					
8746	14:34348	NTIS (US Sales Only), PC A04/MF A01		DE89781573/JAW	MF-000
Lund-MPh–					
87/08	14:35161	NTIS (US Sales Only), PC A03/MF A01		DE89783599/JAW	MF-000
MICROLOG–					
88-05009	14:33891	*See* MU/FEAS–1988			
88-05988	14:34054	*See* GCLL–8804			
89-00470	14:34072	*See* EMR/CRL–88-33			
89-00474	14:33207	*See* EMR/CRL–88-48			
89-00490	14:33848	*See* EMR/MTL–88-29			
89-01130	14:33760	*See* OAF/AE–87-4508			
89-01134	14:33758	*See* OAE–88-5102			
89-01141	14:33759	*See* OAE–88-9000			
89-01190	14:33374	*See* EC/IWD–1988MB			
89-01191	14:33372	*See* EC/IWD–1988AP			
89-01192	14:33375	*See* EC/IWD–1988O			
89-01193	14:33373	*See* EC/IWD–1988BC			
89-01498	14:33660	*See* ASRB–1986			
89-01733	14:34755	*See* TAU–8805-2			
89-01742	14:33212	*See* WU/WCP–50/204			
89-01907	14:33742	*See* PW–DOS			
89-01972	14:33366	*See* NME–1986			
MLM–					
3594	14:34060	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012825/JAW	PC-700; STD-701
MRP/MRL–					
84-60(TR)	14:35195	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89619957/JAW	MF-000
MU/FEAS–					
1988	14:33891	Canada Centre for Mineral and Energy Technology, Technical Information Division, 555 Booth St., Rm. 342, Ottawa, , Canada K1A 0G1; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
N–					
00014-86-K-0139	14:34766	*See* AD-A–201456/1/XAB			
89-16967	14:33892	Issuing Activity			ND-00
NAC–					
88-01	14:34625	the CSIR, National Accelerator Centre, P.O. Box 72, Faure, 7131, South Africa			ND-000
88-02	14:34626	the CSIR, National Accelerator Centre, P.O. Box 72, Faure, 7131, South Africa			ND-000
88-03	14:34249	the CSIR, National Accelerator Centre, P.O Box 72, Faure, 7131, South Africa			ND-000
88-07	14:34687	the CSIR, National Accelerator Centre, P.O. Box 72, Faure, 7131, South Africa			ND-000
NAC-RR–					
664	14:34627	the National Accelerator Centre, Foundation for Research Development, CSIR, P.O. Box 72, Faure, 7131, South Africa			ND-000
665	14:34628	the National Accelerator Centre, Foundation for Research Development, CSIR, P.O. Box 72, Faure, 7131, South Africa			ND-000
NAGRA-NTB–					
85-28	14:33282	Nagra, CH-5401 Baden, Switzerland			ND-000
NAS–					
1.77:20455	14:33892	*See* N–89-16967			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
NASA-TT–					
20455	14:33892	*See* N–89-16967			
NBI-HE–					
89-18	14:35021	NTIS (US Sales Only), PC A03/MF A01		DE89783577/JAW	MF-000
89-19	14:35022	NTIS (US Sales Only), PC A03/MF A01		DE89783578/JAW	MF-000
NEANDC(J)–					
133U	14:33531	*See* JAERI-M–89-026			
NEI-FI–					
75	14:34077	NTIS (US Sales Only), PC A03/MF A01;1		DE89776167/JAW	MF-000
76	14:33607	NTIS (US Sales Only), PC A03/MF A01;1		DE89776166/JAW	MF-000
77	14:33181	NTIS (US Sales Only), PC A04/MF A01;1		DE89776165/JAW	MF-000
NEI-NO–					
61	14:33643	NTIS (US Sales Only), PC A11;3		DE89776220/JAW	MF-000
62	14:33644	NTIS (US Sales Only), PC A07;3		DE89776221/JAW	MF-000
84	14:33185	NTIS (US Sales Only), PC A09/MF A01;1		DE89776210/JAW	MF-000
86	14:33161	NTIS (US Sales Only), PC A09/MF A01;1		DE89776212/JAW	MF-000
87	14:33189	NTIS (US Sales Only), PC A06/MF A01;1		DE89776213/JAW	MF-000
88	14:33174	NTIS (US Sales Only), PC A03/MF A01;1		DE89776214/JAW	MF-000
NEI-SE–					
36	14:33283	NTIS (US Sales Only), PC A11/MF A01 - OSTI; INIS		DE89618326/JAW	MF-000
NIPER–					
415	14:33179	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89000751/JAW	PC-125
82	14:33178	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89000750/JAW	PC-125
NISTIR–					
88/3840	14:33958	*See* PB–89-148381/XAB			
88/3841	14:33900	*See* PB–89-148399/XAB			
NIVA-O–					
82073	14:34490	NTIS (US Sales Only), PC A05/MF A01;1		DE89776216/JAW	MF-000
NKS–					
88-7	14:33585	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89618061/JAW	MF-000
NME–					
1986	14:33366	Dept. of Mines and Energy, PO Box 4750, St. John's, NF, Canada A1C 5T7; $N/C; MF CAN-MET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
NMRDI–					
2-76-5317	14:33193	OSTI - NMRDI Communications Office, Suite M, 457 Washington SE, Albuquerque, NM 87108		TI89014173/JAW	MF-000
NOAA-TM-NMFS-F/NEC–					
61	14:34497	*See* PB–89-139737/XAB			
NRC–					
9012959	14:35424	NTIS, PC A08/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012959/JAW	MF-420
NRL-MR–					
6365	14:34144	*See* AD-A–201635/0/XAB			
NRPB-R–					
227	14:35197	H.M. Stationery Office, London, price Pound 7.00			ND-000
NSS/R–					
118	14:33284	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89618327/JAW	MF-000
NUREG–					
0304-Vol.13-No.4	14:33522	NTIS, PC A07/MF A01 - GPO - OSTI		TI89013219/JAW	MF-000
1174	14:33588	NTIS, PC A03/MF A01 - GPO - OSTI		TI89012602/JAW	MF-000
1341	14:33589	NTIS, PC A03/MF A01 - GPO - OSTI		TI89012960/JAW	MF-000
1353	14:33590	NTIS, PC A06/MF A01 - GPO - OSTI		TI89012222/JAW	MF-000
NUREG/CP–					
0097-Vol.1	14:33591	NTIS, PC A24/MF A01 - GPO - OSTI		TI89012565/JAW	MF-000
NUREG/CR–					
2000-Vol.8-No.4	14:33523	NTIS, PC A09/MF A01 - GPO - OSTI		TI89012939/JAW	MF-000
5193	14:33592	NTIS, PC A17/MF A01 - GPO - OSTI		TI89012938/JAW	MF-000
5235	14:33285	NTIS, PC A03/MF A01 - GPO - OSTI		TI89013697/JAW	MF-000
5257	14:34754	NTIS, PC A06/MF A01 - GPO - OSTI		TI89013698/JAW	MF-000
5391	14:33286	NTIS, PC A17/MF A01 - GPO - OSTI		TI89014184/JAW	MF-000
NVO–					
329	14:34374	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014685/JAW	MF-700
330	14:34375	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013797/JAW	MF-707
331	14:34376	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014686/JAW	MF-700
332	14:34377	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014687/JAW	MF-700

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
OAE–					
88-5102	14:33758	Agricultural Energy Centre (Guelph Agriculture Centre), P.O. Box 1030, Guelph, ON, Canada N1H 6N1; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
88-9000	14:33759	Agricultural Energy Centre (Guelph Agriculture Centre), P.O. Box 1030, Guelph, ON, Canada N1H 6N1; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
OAF/AE–					
87-4508	14:33760	Agricultural Energy Centre (Guelph Agriculture Centre), P.O. Box 1030, Guelph, ON, Canada N1H 6N1; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
OH/RD–					
634G568	14:33429	Canadian Electrical Association, Research & Development, Suite #500, One Westmount Square, Montreal, PQ, Canada H3Z 2P9; $75.00 NON-MEMBERS; MEMBERS: PRICES UPON REQUEST, FUNDS CAN.			ND-000
ORNL–					
6503	14:33285	*See* NUREG/CR–5235			
6539	14:33542	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012904/JAW	PC-525
6546	14:33518	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012740/JAW	MF-530
6547	14:34061	NTIS, PC A07/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013736/JAW	PC-401
ORNL/FTR–					
3051	14:34701	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014753/JAW	MF-408
3260	14:34702	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014724/JAW	MF-407
3265	14:34911	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014180/JAW	MF-410
3266	14:35040	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014731/JAW	MF-413
3268	14:34062	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014749/JAW	MF-401
3273	14:34491	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014732/JAW	MF-402
3277	14:35162	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014181/JAW	MF-414
3278	14:35199	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014751/JAW	MF-407
ORNL/NSIC–					
200-Vol.8-No.4	14:33523	*See* NUREG/CR–2000-Vol.8-No.4			
ORNL/Sub–					
83-43346/03	14:33101	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014788/JAW	MF-114
87-86004/5	14:33433	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013733/JAW	PC-950
ORNL/TM–					
11037	14:33287	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013732/JAW	PC-721
11102	14:35425	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013737/JAW	PC-427
11108	14:34463	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013761/JAW	MF-000
11187	14:33560	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012818/JAW	MF-520
11195	14:34707	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013731/JAW	MF-000
11198	14:35493	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013720/JAW	MF-406
OTA-ITE–					
362	14:34483	*See* PB–89-139018/XAB			
PB–					
89-102545/XAB	14:34492	NTIS, PC A05/MF A01			ND-00
89-117865/XAB	14:33781	NTISPC$75.00/MF$17.00			ND-00
89-117873/XAB	14:33782	NTISPC$232.50/MF$24.50			ND-00
89-117881/XAB	14:33783	NTISPC$73.50/MF$17.00			ND-00
89-117899/XAB	14:33784	NTISPC$41.50/MF$22.50			ND-00
89-117907/XAB	14:33785	NTISPC$249.50/MF$25.50			ND-00
89-117915/XAB	14:33786	NTISPC$180.00/MF$22.00			ND-00
89-117923/XAB	14:33787	NTISPC$64.50/MF$17.00			ND-00
89-117931/XAB	14:33788	NTISPC$130.50/MF$19.50			ND-00
89-117949/XAB	14:33789	NTISPC$122.00/MF$19.50			ND-00
89-117956/XAB	14:33790	NTISPC$27.00/MF$17.00			ND-00
89-117964/XAB	14:33791	NTISPC$110.50/MF$18.50			ND-00
89-117980/XAB	14:33792	NTISPC$27.50/MF$17.00			ND-00
89-117998/XAB	14:33793	NTISPC$38.00/MF$17.00			ND-00
89-135099/XAB	14:34386	NTIS, PC A05/MF A01			ND-00
89-135859/XAB	14:34480	NTIS, PC A08/MF A01			ND-00
89-136493/XAB	14:34664	NTIS, PC A09/MF A01			ND-00
89-136576/XAB	14:34481	NTIS, PC A22/MF A01			ND-00
89-136584/XAB	14:34482	NTIS, PC A15/MF A01			ND-00

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89-137012/XAB	14:34387	NTIS, PC A03/MF A01			ND-00
89-137020/XAB	14:34388	NTIS, PC A03/MF A01			ND-00
89-137038/XAB	14:34389	NTIS, PC A02/MF A01			ND-00
89-137046/XAB	14:34390	NTIS, PC A02/MF A01			ND-00
89-137152/XAB	14:34391	NTIS, PC A03/MF A01			ND-00
89-137285/XAB	14:34392	NTIS, PC A03/MF A01			ND-00
89-137301/XAB	14:34393	NTIS, PC A03/MF A01			ND-00
89-137319/XAB	14:34394	NTIS, PC A03/MF A01			ND-00
89-137327/XAB	14:33168	NTIS, PC A03/MF A01			ND-00
89-137335/XAB	14:33169	NTIS, PC A03/MF A01			ND-00
89-137368/XAB	14:34395	NTIS, PC A02/MF A01			ND-00
89-137376/XAB	14:34396	NTIS, PC A02/MF A01			ND-00
89-137434/XAB	14:34397	NTIS, PC A03/MF A01			ND-00
89-137459/XAB	14:33170	NTIS, PC A03/MF A01			ND-00
89-137467/XAB	14:34398	NTIS, PC A03/MF A01			ND-00
89-137509/XAB	14:34399	NTIS, PC A03/MF A01			ND-00
89-137517/XAB	14:34400	NTIS, PC A03/MF A01			ND-00
89-137806/XAB	14:34401	NTIS, PC A02/MF A01			ND-00
89-137863/XAB	14:34402	NTIS, PC A03/MF A01			ND-00
89-137871/XAB	14:34403	NTIS, PC A03/MF A01			ND-00
89-137889/XAB	14:34404	NTIS, PC A03/MF A01			ND-00
89-137897/XAB	14:34405	NTIS, PC A03/MF A01			ND-00
89-138416/XAB	14:34493	NTIS, PC A03/MF A01			ND-00
89-138432/XAB	14:34494	NTIS, PC A07/MF A01			ND-00
89-138457/XAB	14:34406	NTIS, PC A05/MF A01			ND-00
89-138473/XAB	14:34464	NTIS, PC A09/MF A01			ND-00
89-138663/XAB	14:33794	NTIS, PC A03/MF A01			ND-00
89-138671/XAB	14:33797	NTIS, PC A03/MF A01			ND-00
89-138689/XAB	14:34407	NTIS, PC A06/MF A01			ND-00
89-138713/XAB	14:34408	NTIS, PC A03/MF A01			ND-00
89-138804/XAB	14:34495	NTIS, PC A02/MF A01			ND-00
89-138838/XAB	14:34708	NTIS, PC A05/MF A01			ND-00
89-138853/XAB	14:33761	NTIS, PC A10/MF A01			ND-00
89-138861/XAB	14:34496	NTIS, PC A12/MF A01			ND-00
89-138994/XAB	14:34409	NTIS, PC A03/MF A01			ND-00
89-139018/XAB	14:34483	NTIS, PC A05/MF A01			ND-00
89-139042/XAB	14:33177	NTIS, PC A03/MF A01			ND-00
89-139224/XAB	14:34631	NTIS, PC A02/MF A01			ND-00
89-139232/XAB	14:34410	NTIS, PC A03/MF A01			ND-00
89-139240/XAB	14:34411	NTIS, PC A03/MF A01			ND-00
89-139257/XAB	14:34412	NTIS, PC A03/MF A01			ND-00
89-139265/XAB	14:34413	NTIS, PC A03/MF A01			ND-00
89-139497/XAB	14:33798	NTIS, PC A04/MF A01			ND-00
89-139570/XAB	14:34414	NTIS, PC A03/MF A01			ND-00
89-139653/XAB	14:33136	NTIS, PC A07/MF A01			ND-00
89-139737/XAB	14:34497	NTIS, PC A03/MF A01			ND-00
89-139752/XAB	14:33799	NTIS, PC A06/MF A01			ND-00
89-139943/XAB	14:34865	NTIS, PC A07/MF A01			ND-00
89-139976/XAB	14:33659	NTIS, PC A25/MF A01			ND-00
89-140016/XAB	14:34498	NTIS, PC A03/MF A01			ND-00
89-140024/XAB	14:34499	NTIS, PC A04/MF A01			ND-00
89-140040/XAB	14:33645	NTIS, PC A04/MF A01			ND-00
89-140180/XAB	14:34415	NTIS, PC A03/MF A01			ND-00
89-140198/XAB	14:34416	NTIS, PC A03/MF A01			ND-00
89-140206/XAB	14:34417	NTIS, PC A04/MF A01			ND-00
89-140214/XAB	14:34418	NTIS, PC A03/MF A01			ND-00
89-140230/XAB	14:34419	NTIS, PC A02/MF A01			ND-00
89-140255/XAB	14:34420	NTIS, PC A03/MF A01			ND-00
89-140263/XAB	14:34421	NTIS, PC A03/MF A01			ND-00
89-140271/XAB	14:34422	NTIS, PC A03/MF A01			ND-00
89-140297/XAB	14:34423	NTIS, PC A03/MF A01			ND-00
89-140834/XAB	14:33199	NTIS, PC A04/MF A01			ND-00
89-140842/XAB	14:33741	NTIS, PC A06/MF A01			ND-00
89-140867/XAB	14:33190	NTIS, PC A15/MF A01			ND-00
89-140875/XAB	14:33191	NTIS, PC A06/MF A01			ND-00
89-141063/XAB	14:34512	NTIS, PC A09/MF A01			ND-00
89-142368/XAB	14:33762	NTIS, PC A13/MF A01			ND-00
89-142376/XAB	14:33763	NTIS, PC A23/MF A01			ND-00
89-142525/XAB	14:33764	NTIS, PC A03/MF A01			ND-00
89-142574/XAB	14:33194	NTIS, PC A06			ND-00
89-142582/XAB	14:33195	NTIS, PC A10			ND-00

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89-142590/XAB	14:33389	NTIS, PC A03/MF A01			ND-00
89-142608/XAB	14:33102	NTIS, PC A12/MF A01			ND-00
89-142624/XAB	14:33201	NTIS, PC A16/MF A01			ND-00
89-143028/XAB	14:34500	NTIS, PC A08/MF A01			ND-00
89-143424/XAB	14:33749	NTIS, PC A05/MF A01			ND-00
89-145080/XAB	14:33200	NTIS, PC A06/MF A01			ND-00
89-145288/XAB	14:33750	NTIS, PC A09/MF A01			ND-00
89-146302/XAB	14:33196	NTIS, PC A11/MF A01			ND-00
89-148381/XAB	14:33958	NTIS, PC A05/MF A01			ND-00
89-148399/XAB	14:33900	NTIS, PC A05/MF A01			ND-00
89-148829/XAB	14:33103	NTIS, PC A08/MF A01			ND-00
89-148837/XAB	14:33765	NTIS, PC A14/MF A01			ND-00
89-148845/XAB	14:33766	NTIS, PC A08/MF A01			ND-00
89-148894/XAB	14:33192	NTIS, PC A06/MF A01			ND-00
89-148928/XAB	14:33353	NTIS, PC A04/MF A01			ND-00
89-149306/XAB	14:34465	NTIS, PC A06/MF A01			ND-00
89-155055/XAB	14:34424	NTIS, PC A06/MF A01			ND-00
89-160931/XAB	14:33647	NTIS, PC A11/MF A01			ND-00
89-162275/XAB	14:34513	NTIS, PC A03/MF A01			ND-00
89-855282/XAB	14:34149	NTISPC N01/MF N01			ND-00
89-855803/XAB	14:33175	NTISPC N01/MF N01			ND-00
89-855811/XAB	14:34709	NTISPC N01/MF N01			ND-00
89-855894/XAB	14:34459	NTISPC N01/MF N01			ND-00
89-855902/XAB	14:34460	NTISPC N01/MF N01			ND-00
89-855969/XAB	14:33959	NTISPC N01/MF N01			ND-00
89-855977/XAB	14:33960	NTISPC N01/MF N01			ND-00
89-855993/XAB	14:34466	NTISPC N01/MF N01			ND-00
89-856124/XAB	14:34710	NTISPC N01/MF N01			ND-00
89-856165/XAB	14:34204	NTISPC N01/MF N01			ND-00
89-856215/XAB	14:33961	NTISPC N01/MF N01			ND-00
89-856223/XAB	14:33962	NTISPC N01/MF N01			ND-00
89-856280/XAB	14:33767	NTISPC N01/MF N01			ND-00
89-856298/XAB	14:33768	NTISPC N01/MF N01			ND-00
89-856322/XAB	14:33985	NTISPC N01/MF N01			ND-00
89-856330/XAB	14:33362	NTISPC N01/MF N01			ND-00
89-856421/XAB	14:33769	NTISPC N01/MF N01			ND-00
PCCF-T–					
8811	14:35163	NTIS (US Sales Only), PC A07/MF A01		DE89781524/JAW	MF-000
PNE–					
328	14:34377	*See* NVO–332			
523	14:34376	*See* NVO–331			
912F	14:34375	*See* NVO–330			
961	14:34374	*See* NVO–329			
PNL–					
6250	14:34629	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012874/JAW	MF-510
6874	14:33288	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014622/JAW	MF-510
6910	14:34425	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014794/JAW	MF-602
POEF-A–					
355	14:33289	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013805/JAW	MF-722
PPA-T–					
71	14:33901	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89617929/JAW	MF-000
79	14:34350	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89618253/JAW	MF-000
PPLK–					
9	14:35426	NTIS (US Sales Only), PC A25/MF A01		DE89778200/JAW	MF-000
PPPL–					
2626	14:35427	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013401/JAW	PC-427
PRRC–					
88-12	14:33193	*See* NMRDI–2-76-5317			
PTB-Opt–					
29	14:33390	NTIS (US Sales Only), PC A04/MF A01;1		DE89783056/JAW	MF-000
PTB-Ra–					
22	14:34351	NTIS (US Sales Only), PC A03/MF A01		DE89783055/JAW	MF-000
PW–					
DOS	14:33742	Public Works Canada, Information Research & Library Services, Sir Charles Tupper Bldg., Confederation Heights, Ottawa, ON, Canada K1A 0M2; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
RAL–					
89-015	14:33902	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89619580/JAW	MF-000

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89-018	14:34352	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89620312/JAW	MF-000
RDA-TR–					
144200-002	14:34929	*See* AD-A–201263/1/XAB			
REPT–					
87-60756	14:33765	*See* PB–89-148837/XAB			
88-61241	14:33766	*See* PB–89-148845/XAB			
RF-SPS-A–					
24/85	14:33162	NTIS (US Sales Only), PC A03/MF A01;1		DE89776217/JAW	MF-000
RFP–					
4302	14:33290	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014688/JAW	MF-721
4317	14:34063	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013523/JAW	MF-732
RFP-Trans–					
499	14:34128	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013795/JAW	MF-706
RISO-M–					
2739	14:34064	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89617894/JAW	MF-000
2740	14:34912	NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS		DE89617595/JAW	MF-000
2770	14:34205	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89620175/JAW	MF-000
RRK–					
88-33	14:34866	NTIS (US Sales Only), PC A03/MF A01		DE89778050/JAW	MF-000
88-35	14:34867	NTIS (US Sales Only), PC A03/MF A01		DE89778051/JAW	MF-000
88-36	14:34868	NTIS (US Sales Only), PC A02/MF A01		DE89778049/JAW	MF-000
RSRE-MEMO–					
4197	14:35480	*See* AD-A–201603/8/XAB			
SAND–					
-88-3475C	14:34212	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013074/JAW	MF-000
87-1575	14:33291	NTIS, PC A10/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012872/JAW	MF-810
87-7174	14:33292	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012880/JAW	MF-815
88-0930	14:34369	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013347/JAW	MF-700
88-1230	14:34373	*See* AD-A–201247/4/XAB			
88-1721	14:33593	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012878/JAW	MF-610
88-1761C	14:33493	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89001668/JAW	MF-523
88-1824	14:33592	*See* NUREG/CR–5193			
88-2145C	14:33459	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89003168/JAW	MF-706
88-2203C	14:33524	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89001666/JAW	MF-700
88-2209C	14:33539	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89005234/JAW	MF-700
88-3238C	14:35464	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013067/JAW	MF-712
88-3239C	14:34370	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89010771/JAW	MF-741
88-3335C	14:34306	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013565/JAW	MF-712
88-3367C	14:34065	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014739/JAW	MF-704
88-3408C	14:33687	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89011512/JAW	MF-706
88-3427C	14:34307	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013165/JAW	MF-700
88-3486	14:34213	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012248/JAW	MF-15
88-7170C	14:33544	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89005210/JAW	MF-706
89-0048C	14:34214	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013152/JAW	MF-706
89-0071C	14:34227	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013153/JAW	MF-700
89-0080C	14:34232	NTIS, PC A - OSTI; GPO Dep.	E 1.99:	DE89014705/JAW	MF-700
89-0081C	14:34250	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012638/JAW	MF-700
89-0090C	14:34371	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89006510/JAW	MF-741
89-0091C	14:35465	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013814/JAW	MF-712
89-0181C	14:34215	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89006765/JAW	MF-706
89-0192	14:35509	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012879/JAW	MF-700
89-0218C	14:34216	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89006725/JAW	MF-705; MN-706
89-0274C	14:35466	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012639/JAW	MF-712
89-0276C	14:35467	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013562/JAW	MF-712
89-0289C	14:35510	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013497/JAW	MF-700
89-0299C	14:34308	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013089/JAW	MF-712
89-0372	14:33293	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012873/JAW	MF-802
89-0379C	14:34360	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89007419/JAW	MF-706
89-0393C	14:34129	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89011881/JAW	MF-706; MN-705
89-0459C	14:35494	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89008686/JAW	MF-705; MN-713
89-0484	14:34130	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012239/JAW	MF-705
89-0490C	14:34206	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89008710/JAW	MF-704
89-0589C	14:34366	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89008684/JAW	MF-706
89-0633C	14:34207	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89008580/JAW	MF-704
89-0664C	14:33986	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89009831/JAW	MF-704

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
89-0683C	14:33903	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89009946/JAW	MF-704
89-0838C	14:33294	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013520/JAW	MF-703; MN-721
89-0843	14:33904	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012864/JAW	MF-704
89-0858	14:33545	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012881/JAW	MF-700
89-0940C	14:33295	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013490/JAW	MF-722
89-0941C	14:34131	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013526/JAW	MF-722
89-0959C	14:33296	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013449/JAW	MF-722
89-0960C	14:33297	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013473/JAW	MF-722
89-0979C	14:33298	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013521/JAW	MF-722
89-0980C	14:33299	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013491/JAW	MF-722
89-0981C	14:33300	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013160/JAW	MF-722
89-0982C	14:33301	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013163/JAW	MF-722
89-0983C	14:34132	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013561/JAW	MF-722
89-0987C	14:34133	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013488/JAW	MF-722
89-0988C	14:33302	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013161/JAW	MF-722
89-0992C	14:33303	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013519/JAW	MF-722
89-1007C	14:33304	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013489/JAW	MF-722
89-1112C	14:35472	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014744/JAW	MF-700
89-1114C	14:33334	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014745/JAW	MF-700
89-1137C	14:33305	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013518/JAW	MF-722
89-1282C	14:33987	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013162/JAW	MF-213
89-1285C	14:33306	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012637/JAW	MF-814
89-1300C	14:33963	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013560/JAW	MF-704
89-1435C	14:33156	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014692/JAW	MF-122
89-1458C	14:35468	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014782/JAW	MF-712
89-1494C	14:35469	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013493/JAW	MF-712
89-1602C	14:33335	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014800/JAW	MF-700; MN-705
89-7071C	14:33307	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013527/JAW	MF-722
89-7082C	14:35297	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013496/JAW	MF-706
SERI/SP–					
220-3486	14:33427	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89000876/JAW	MF-261
SERI/STR–					
211-3512	14:33391	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89009430/JAW	MF-271
SERI/TP–					
254-3492	14:33743	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89000870/JAW	MF-232
SERI/TR–					
215-3323	14:33408	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89000839/JAW	MF-234; MN-235
SGD–					
531-PT-1	14:34865	*See* PB–89-139943/XAB			
SKB-SP-TR–					
88-05	14:33308	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89618329/JAW	MF-000
88-06	14:33309	NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS		DE89618330/JAW	MF-000
SKB-TR–					
88-06	14:34725	NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS		DE89617978/JAW	MF-000
88-17	14:33905	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89617947/JAW	MF-000
SKI–					
84089	14:33310	NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS		DE89618331/JAW	MF-000
86076(pt.1)	14:34508	NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS		DE89617981/JAW	MF-000
86076(pt.2)	14:34509	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89617982/JAW	MF-000
86151-1	14:33540	NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS		DE89618194/JAW	MF-000
86151-2	14:33541	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89618195/JAW	MF-000
87132	14:34479	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89617962/JAW	MF-000
SKI-TR–					
88-1	14:33310	*See* SKI–84089			
SLAC–					
334	14:34233	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013387/JAW	PC-414
SLAC-PUB–					
4868	14:34234	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013748/JAW	PC-414
4907	14:34251	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013745/JAW	PC-414
4919	14:34252	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013744/JAW	PC-414
4936	14:34235	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013754/JAW	PC-414
4939	14:34353	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013743/JAW	PC-414
4953	14:34253	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013742/JAW	PC-414
4974	14:34309	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013741/JAW	PC-414

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
SNV–					
3169	14:33176	NTIS (US Sales Only), PC A05/MF A01;1		DE89776222/JAW	MF-000
3379	14:34426	NTIS (US Sales Only), PC A08/MF A01;1		DE89776250/JAW	MF-000
3380	14:34427	NTIS (US Sales Only), PC A09/MF A01;1		DE89776251/JAW	MF-000
3461	14:33795	NTIS (US Sales Only), PC A03/MF A01;1		DE89776227/JAW	MF-000
3481	14:34221	NTIS (US Sales Only), PC A04/MF A01;1		DE89776228/JAW	MF-000
3486	14:34222	NTIS (US Sales Only), PC A05/MF A01;1		DE89776229/JAW	MF-000
3497	14:34510	NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS		DE89618012/JAW	MF-000
SOL–					
89-3	14:35495	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013115/JAW	MF-405
89-4	14:35496	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013483/JAW	MF-405
89-5	14:35497	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013116/JAW	MF-405
SSI–					
88-05	14:33311	NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS		DE89618332/JAW	MF-000
88-08	14:33525	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89618361/JAW	MF-000
88-10	14:35200	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89618071/JAW	MF-000
88-18	14:34703	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89618006/JAW	MF-000
STEV–					
1988-R12	14:33774	NTIS (US Sales Only), PC A05/MF A01;1		DE89776267/JAW	MF-000
1988-R16	14:33775	NTIS (US Sales Only), PC A04/MF A01;1		DE89776268/JAW	MF-000
STEV-FBT–					
89-10	14:33144	NTIS (US Sales Only), PC A05/MF A01;1		DE89776261/JAW	MF-000
89-16	14:34223	NTIS (US Sales Only), PC A03/MF A01;1		DE89776266/JAW	MF-000
89-21	14:34066	NTIS (US Sales Only), PC A03/MF A01;1		DE89776263/JAW	MF-000
STEV-TORV–					
89-4	14:33034	NTIS (US Sales Only), PC A04/MF A01;1		DE89776264/JAW	MF-000
STU–					
83-5812	14:33796	NTIS (US Sales Only), PC A03/MF A01;1		DE89776225/JAW	MF-000
86-3932	14:33988	NTIS (US Sales Only), PC A03/MF A01;1		DE89776224/JAW	MF-000
STUDSVIK-ED–					
87-34	14:33776	*See* SVF–315			
STUDSVIK-EP–					
88-30	14:33143	*See* LUTMDN-TMVK–5172-1-90-1988			
STUDSVIK-NP–					
87-86	14:34508	*See* SKI–86076(pt.1)			
87-91	14:34509	*See* SKI–86076(pt.2)			
STUDSVIK-STSR–					
1	14:33494	NTIS (US Sales Only), PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013226/JAW	MF-523
2	14:33495	NTIS (US Sales Only), PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013227/JAW	MF-523
3	14:33496	NTIS (US Sales Only), PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013228/JAW	MF-523
4	14:33463	NTIS (US Sales Only), PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013229/JAW	MF-523
5	14:33497	NTIS (US Sales Only), PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013230/JAW	MF-523
6	14:33498	NTIS (US Sales Only), PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013231/JAW	MF-523
7	14:33499	NTIS (US Sales Only), PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013232/JAW	MF-523
8	14:33543	NTIS (US Sales Only), PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013233/JAW	MF-523
9	14:33500	NTIS (US Sales Only), PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013234/JAW	MF-523
10	14:33501	NTIS (US Sales Only), PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013235/JAW	MF-523
13	14:33502	NTIS (US Sales Only), PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013238/JAW	MF-523
14	14:33464	NTIS (US Sales Only), PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013239/JAW	MF-523
15	14:33465	NTIS (US Sales Only), PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013240/JAW	MF-523
16	14:33503	NTIS (US Sales Only), PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013241/JAW	MF-523
18	14:33504	NTIS (US Sales Only), PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013243/JAW	MF-523
20	14:33505	NTIS (US Sales Only), PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013245/JAW	MF-523
22	14:33466	NTIS (US Sales Only), PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013247/JAW	MF-523

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
25	14:33467	NTIS (US Sales Only), PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013250/JAW	MF-523
26	14:33468	NTIS (US Sales Only), PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013251/JAW	MF-523
27	14:33469	NTIS (US Sales Only), PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013252/JAW	MF-523
28	14:33470	NTIS (US Sales Only), PC A07/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013253/JAW	MF-523
29	14:33471	NTIS (US Sales Only), PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013254/JAW	MF-523
30	14:33472	NTIS (US Sales Only), PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013255/JAW	MF-523
31	14:33473	NTIS (US Sales Only), PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013256/JAW	MF-523
32	14:33474	NTIS (US Sales Only), PC A11/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013016/JAW	MF-523
STUDSVIK-STSRX–					
5	14:33475	NTIS (US Sales Only), PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012712/JAW	MF-523
6	14:33476	NTIS (US Sales Only), PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012713/JAW	MF-523
8	14:33506	NTIS (US Sales Only), PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012715/JAW	MF-523
SUPRI-TR–					
66	14:33154	*See* DOE/BC/14126–7			
67	14:33160	*See* DOE/BC/14126–8			
SV–					
2000-88-1201	14:33744	NTIS (US Sales Only), PC A03/MF A01;1		DE89776226/JAW	MF-000
SV-UB–					
1988-15	14:34134	NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS		DE89618147/JAW	MF-000
SV-UK–					
1987-15	14:35479	NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS		DE89618370/JAW	MF-000
SVF–					
291	14:33477	NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS		DE89618208/JAW	MF-000
312	14:34428	NTIS (US Sales Only), PC A04/MF A01;1		DE89776242/JAW	MF-000
315	14:33776	NTIS (US Sales Only), PC A04/MF A01;1		DE89776243/JAW	MF-000
316	14:34078	NTIS (US Sales Only), PC A04/MF A01;1		DE89776244/JAW	MF-000
318	14:33777	NTIS (US Sales Only), PC A04/MF A01;1		DE89776245/JAW	MF-000
322	14:33447	NTIS (US Sales Only), PC A06/MF A01;1		DE89776246/JAW	MF-000
323	14:33434	NTIS (US Sales Only), PC A03/MF A01;1		DE89776247/JAW	MF-000
324	14:33145	NTIS (US Sales Only), PC A05/MF A01;1		DE89776248/JAW	MF-000
325	14:33124	NTIS (US Sales Only), PC A05/MF A01;1		DE89776249/JAW	MF-000
TAU–					
8805-2	14:34755	Canada Centre for Mineral and Energy Technology, Technical Information Division, 555 Booth St., Rm. 342, Ottawa, ON, Canada K1A 0G1; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
TKK-F–					
B110	14:33608	NTIS (US Sales Only), PC A04/MF A01;1		DE89776172/JAW	MF-000
TKK-KO/ET–					
23	14:33035	NTIS (US Sales Only), PC A09/MF A01;1		DE89776169/JAW	MF-000
31	14:34100	NTIS (US Sales Only), PC A04/MF A01;1		DE89776168/JAW	MF-000
TKK-KO/LVI–					
B18	14:33745	NTIS (US Sales Only), PC A06/MF A01;1		DE89776183/JAW	MF-000
B19	14:33746	NTIS (US Sales Only), PC A08/MF A01;1		DE89776173/JAW	MF-000
TR–					
0086A(2925-04)-1	14:34145	*See* AD-A–201641/8/XAB			
4442-209-88	14:33741	*See* PB–89-140842/XAB			
86-3	14:33610	*See* AD-A–201645/9/XAB			
TRB/TRR–					
1164	14:33798	*See* PB–89-139497/XAB			
TRITA-EPP–					
88-02	14:34889	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89617990/JAW	MF-000
88-03	14:34890	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89617991/JAW	MF-000
88-04	14:34869	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89617764/JAW	MF-000
88-07	14:34870	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89617765/JAW	MF-000
TRITA-PFU–					
88-04	14:35428	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89617658/JAW	MF-000
88-05	14:35429	NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS		DE89617634/JAW	MF-000

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
88-06	14:35430	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89617675/JAW	MF-000
UCB-NE–					
4128	14:33279	*See* LBL–25768			
4129	14:33278	*See* LBL–25767			
4132	14:33281	*See* LBL–26672			
4135	14:35491	*See* LBL–26700			
4143	14:35492	*See* LBL–27044			
UCID–					
21466	14:33312	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013383/JAW	MF-814
21542-89-1	14:33313	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013713/JAW	MF-732
21656	14:35498	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013380/JAW	MF-705
21675	14:34135	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013385/JAW	MF-707
21706	14:35395	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013384/JAW	MF-712
21729	14:34217	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013382/JAW	MF-700
UCRL–					
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